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REPORTS

FROM

COMMITTEES:

SIXTEEN VOLUMES.

—*(1.)*—

ACCIDENTS IN MINES;

ARTS AND MANUFACTURES.

Session

19 *February* —— 10 *September* 1835.

VOL. V.

1835.

REPORTS FROM COMMITTEES:

1835.

SIXTEEN VOLUMES:—CONTENTS OF THE

FIRST VOLUME.

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REPORT

FROM THE

SELECT COMMITTEE

ON

ACCIDENTS IN MINES;

TOGETHER WITH THE

MINUTES OF EVIDENCE,

AND INDEX.

Ordered, by The House of Commons, *to be Printed,*
4 *September* 1835.

603.

Martis, 2° die Junii, 1835.

Ordered, That a Select Committee be appointed to inquire into the Nature, Cause and Extent of those lamentable Catastrophes which have occurred in the Mines of Great Britain, with the view of ascertaining and suggesting the means for preventing the recurrence of similar fatal Accidents.

And a Committee was appointed of,—

Mr. Pease.
Lord John Russell.
Mr. Fox Maule.
Sir Matthew White Ridley.
Mr. Ord.
Mr. Lambton.
Sir Hedworth Williamson.
Mr. Arthur Trevor.
Mr. Harland.
Mr. Bowes.
Mr. George Frederick Young.
Mr. John Henry Vivian.
Mr. John Davenport.
Mr. Alderman Copeland.
Mr. Alderman Thompson.
Mr. David Barclay.
The O'Connor Don.
Sir George Strickland.
Lord Viscount Lowther.
Mr. Irton.
Mr. Biddulph.
Mr. Mostyn.
Sir William Trelawney.
Mr. Baines.
Mr. Mackinnon.
Mr. Hindley.
Mr. Hawkes.
Mr. Brotherton.
Mr. Guest.
Mr. Ball.
Mr. Rippon.
Mr. Gully.
Sir John Wrottesley.
Mr. Thornely.
Sir Philip Durham.

Ordered, That the Committee have power to send for Persons, Papers and Records.

Ordered, That Five be the Quorum of the Committee.

Veneris, 5° die Junii, 1835.

Ordered, That Mr. Ingham, Sir William Molesworth, Mr. Halse, Mr. Rundle, Mr. Heathcote, Mr. Villiers, and Mr. Hardy, be added to the Committee.

Veneris, 4° die Septembris, 1835.

Ordered, That the Committee have power to report their Opinion, together with the Minutes of the Evidence taken before them.

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REPORT.

THE SELECT COMMITTEE appointed to inquire into the Nature, Cause and Extent of those lamentable Catastrophes which have occurred in the MINES of *Great Britain*, with the view of ascertaining and suggesting the Means of preventing the recurrence of similar fatal Accidents, and who were empowered to report the MINUTES OF THE EVIDENCE taken before them to The House; ——HAVE inquired into the Matter referred to them, and have agreed upon the following REPORT:

YOUR Committee have called before them Witnesses connected with all the great Mining Districts of the Kingdom. They have also examined Plans, Diagrams, and a great variety of Lamps.

To the Evidence which accompanies this Report, Your Committee solicit the attention of The House.

Your Committee have had ample opportunity of multiplying proofs of the calamities which have occurred in the Mines of this kingdom by sudden explosions of Fire-damp, Foul-air, or Sulphur, all which terms are locally applied to Carburetted Hydrogen Gas, so copiously evolved in many of those Mines. Few Collieries are entirely free from fire-damp, but in many the quantity emitted is so large, that in spite of skill and unremitting attention, the risk is constant and imminent. 1514. 2690. 3765 2030.

Having alluded to the *nature and cause* of the accidents which have taken place, Your Committee proceed to report upon the extent of the mischief which has resulted to property and human life.

The amount of damage sustained by these explosions is described by several Witnesses to have been great, and, when estimated in connexion with losses arising from interrupted trade, enormous; it is nevertheless rather with reference to the cause and interests of humanity than in a pecuniary point of view that this inquiry has assumed its just importance. 1524. 1666. 773.

Your Committee have failed in obtaining accurate information as to the number of lives lost within a limited period. Many documents, however, have been produced, from which much correct information on this portion of their inquiry has been derived.

In the course of the last Session certain returns were made by the Clerks of the Peace of Inquests held by the Coroners on parties who had met with untimely deaths in the Mines of England and Wales. These Returns were very defective: from some counties the required information could not be obtained; in others, the nature of the accidents reported was not mentioned. They gave a total of 954 persons who had perished during the last 25 years. The following is a Summary:

Chester - - -	lives lost	7	- fire-damp and choke-damp.
Cumberland - -	ditto	140	- ditto - - ditto.
Derby - - -	ditto	19	- ditto - - - ditto.
Gloucester - -	ditto	3	- ditto - - - ditto.
Monmouth - -	ditto	3	- ditto - - - ditto.
Nottingham - -	ditto	18	- ditto - - - ditto.
Salop - - -	ditto	89	- ditto - - - ditto.
Somerset - - -	ditto	1	- ditto - - - ditto.
Stafford, one district -	ditto	104	- ditto - - - ditto.
Warwick - -	ditto	3	- ditto - - - ditto.
York, North Riding -	ditto	29	- ditto - - - ditto.
York, West Riding -	ditto	23	- choke-damp.
Ditto - -	ditto	93	- fire-damp.
Ditto - -	ditto	230	- other accidents not specified.
Brecon - - -	ditto	15	- ditto.
Ditto - - -	ditto	3	- explosions.
Flint - - -	ditto	39	- choke-damp and fire-damp.
Lancashire (no returns for several districts) - -	ditto	135	- ditto - - ditto.
		954	

Many of the counties and divisions of counties from which no returns have been received are those wherein Your Committee have reason to believe catastrophes have occurred, which would have materially swelled the catalogue. The counties of Durham and Northumberland, it will be observed, are omitted. As respects these, the most important of all, the exertions of an able and indefatigable collector have supplied the de-
Page 224. ficiency. Mr. John Sykes, of Newcastle, in his published "Local Records" of those counties, presented the public with a list of accidents from an early period. The general correctness of that list has been proved;
2377. 2954. it was revised and amended by Mr. Buddle, who affixed an asterisk opposite the names of the Collieries which came under his personal notice at the times named. Those melancholy details are confined to what has happened on the banks of the Rivers Tyne and Wear since the year 1710. It appears that in those districts alone

There perished	1,479	by explosions of fire-damp.
—	84	by inundations.
—	37	by other casualties.
	1,600	- Total since 1710.

The list as drawn out furnishes an account, from 1810, of 1,125 lives lost; this, added to the general returns already alluded to, (defective and vastly short of the total as Your Committee believe them to be,) gives the number of fatal accidents for the last 25 years, 2,070. One striking fact requires to be particularly pointed out. If the year 1816 is assumed as the period when Sir Humphrey Davy's lamp came into use, a term of 18 years since 1816, and a similar term prior to 1816 being taken, it will be seen, that in the 18 years previous to the introduction of the lamp 447 persons lost their lives in the counties
See page 224. of Durham and Northumberland, whilst in the latter term of 18 years the fatal accidents amounted to 538. To account for this increase, it may be sufficient to observe, that the quantity of coal raised in the said coun-
1639. ties has greatly increased; seams of coal, so fiery as to have lain
758. unwrought, have been approached and worked by the aid of the safety-lamp.

lamp. Many dangerous Mines were successfully carried on, though in a most inflammable state, and without injury to the general health of the people employed in them. Add to this the idea entertained, that on the introduction of that lamp the necessity for former precautions and vigilance in great measure ceased. 1417. 1491. 363. 1621. 1859. 1413. 1623. 1646.

These facts led Your Committee to a serious part of their inquiry, How are these calamities to be prevented for the future? They desire fully to recognise the undoubted rights of property, enterprise and labour. They acknowledge their conviction, that the public interest has been served by the opening of the more dangerous Mines, and the competition their working has created; they do not overlook the anxious care alleged to have been maintained to diminish the attendant risk; but they deem it their duty to state their decided opinion, that the interests of humanity demand consideration, and they would gladly put it to the owners of these Mines how far any object of pecuniary interest or personal gain, or even the assumed advantages of public competition, can justify the continued exposure of men and boys in situations where science and mechanical skill have failed in providing anything like adequate protection. 2396. 1794. 1799. 2069. 2090. 2165.

Immediately after their appointment, Your Committee received intelligence that a most awful and melancholy catastrophe had taken place at Wallsend Colliery, between Newcastle-on-Tyne and Shields. Having called for a copy of the Evidence taken by the Coroner, it has been produced, and accompanies this Report. The particulars it contains, extracted in the course of an able and patient investigation, and the further elucidation of the case, as contained in the Evidence of Mr. Buddle before Your Committee, are of a deeply interesting character, the whole furnishing an example of a most dangerous Mine, which, though conducted on principles sanctioned by some of the most eminent colliery viewers and best pitmen, cannot be considered secure from the recurrence of similar calamities. Your Committee refer to the verdict of the jury, and to a Document (pp. 177–78) containing the opinions of a highly respectable meeting held in Newcastle, as proofs, that in the judgment of well-informed individuals, no reasonable precaution had been omitted. The melancholy result was, that in an instant 101 men and boys were killed. 1239. Pages 179. 190.

Here Your Committee would observe, that without any disposition to question the zealous and faithful discharge of their important duties by local Coroners and Juries, it may be expedient to consider how far it is necessary to provide that at the earliest possible opportunity information of every accident attended with death to a large number of His Majesty's subjects should be transmitted to the Secretary of State for the Home Department, and that he, or the Chief Justice of England, His Majesty's Coroner, should, at his or their discretion, direct the attendance of some fit and proper person or persons, by them to be appointed, to be present at and assist the said Coroner and the Jury in their investigations. From such a proceeding results the most valuable to humanity and science might be obtained; the aim of justice would be still better secured, and to the public (particularly the relations of the deceased), the verdict would be delivered under the best possible recommendation, and with the highest sanction. 2281. 2264.

The presence of carbonic acid gas, or choke-damp, though less sudden and violent in its consequences, has proved a fatal attendant of the miner in innumerable instances, and this in districts where explosions are rare and insignificant. Other noxious gases, varying in kind and combination, are also stated to exist in certain Mines, and furnish additional subjects for chemical investigation. Inundations of water have occasionally been very destructive. There still remains a long list of casualties, some of which are wholly beyond human control, inseparable 1528. 1849. 2375. 3345. 684. 2506. 876. 2366. 1824. 2450.

1779. 2040. 2051. 2191. 2252. 2351. 2955. 1082. 1132. from mining pursuits, and their fatal results are often justly attributed to ignorance or a wanton neglect of ordinary caution, and a recklessness of danger in defiance of common discretion.

Your Committee, strongly impressed with the paramount importance of that part of the question referred to them which calls upon them to investigate the best method of preventing the recurrence of these calamities, have assiduously and anxiously inquired into the nature and success of the means already adopted. In this part of the inquiry Your Committee have had the voluntary and valuable aid of philanthropic and scientific individuals, to whom the community is greatly indebted. The means of prevention may be divided under three heads: 1. Ventilation; 2. Safety-lamps; 3. Maps or Plans.

1605. 1. Ventilation, by which is meant, an adequate supply of atmospherical air sufficient as an active agent to displace deleterious gases, or so to adulterate those gases as to leave them no longer explosive, or, as in the 527. case of carbonic acid gas, no longer fatal to vitality. On ventilation, and the daily, unceasing, strict discharge of duty by every person en- 1567. 1613. gaged about the Mines, from the scientific, professional viewer, through all grades, the under viewer, the wasteman, the overman, the deputy, 1611. 1616. 1620. 2045. 2068. 2253. 2965. 586. 2995. 1126. 1128. 1482. the lamp-keeper, the pitman, down to the trapper (often a boy too young and thoughtless who manages the air-doors), depends the safety of hundreds of men and boys, from minute to minute; one act of omission of assigned duty, one solitary, momentary neglect, may cause the instant destruction of life and property to an indefinite extent.

2. Safety-lamps; by the aid of which the miner is enabled to commence and continue his operations in situations where no naked light could be 1961. used, and at other times as a precaution against apprehended sudden changes in the atmosphere which surrounds him.

1092. 1363. 1391. 3. Maps or plans, accurately defining not only the mode of conducting the air-courses, but the entire of the workings, pointing out also the position of adjacent abandoned Mines, which may have become reservoirs of gas or of water.

1562. 1568. 1988. 1994. 2095. 2612. 2853. 2916. 3018. 3153. 896. 983. The various modes of ventilating Mines already in use, as well as those systems which have given place to improved methods, will be found detailed by various witnesses, and their merits so fully canvassed, as to require no comment from Your Committee. To enter upon a review of every plan and suggestion would compel Your Committee to exceed the reasonable limits of a Report. They do not hesitate to express a con- 2324. viction, that whilst some Mines equally foul are naturally freed from large accumulations of gas, by the approximation of the seams of coal to the surface of the earth, others, where the seams lie horizontally, or nearly so, require more shafts, additional opportunities for the injection of pure air and the rejection of foul than are ordinarily afforded. 2152. A less parsimonious system in this respect, in the original design of those Mines, and in their subsequent working, would have rendered easy otherwise difficult ventilation, and saved many valuable lives. The absolute necessity of greater attention to this point has been fully established.

1606. 1651. 2124. 2128. 2307. 2341. The practice of placing wooden partitions or brattices in the ventilating shafts is deservedly reprobated; the slightest explosion may remove them, thus the whole system of ventilation is destroyed, and no timely aid can be rendered to the temporarily surviving sufferers. Your Committee have reason to believe that this opinion is generally adopted in 2133. the coal mining districts. To this point they attach an importance, inferior only to the provision of a sufficient number of up-cast and 2046. 2173. 3647. down-cast shafts. They consider that the Evidence justifies the suspicion 2176. 4079. that the foul and free air-courses are frequently too near to each other, the communications not adequately protected, and that the lengths of air-coursing

air-coursing are excessive, giving opportunities for leakage, interruption and contamination. The temporary nature of the stoppings, often boards imperfectly united, sometimes mere heaps of small coal, and their frequent derangement, inevitably produce dangerous consequences. 1587. 1644. 2540. 1695. 3383.

Your Committee have endeavoured to investigate with strict impartiality the merits of the different Lamps which have been brought under their notice. In the course of the Evidence many varieties will be found described. The invention claimed by the late Sir Humphrey Davy, on principles demonstrated by that able philosopher, may be considered as having essentially served the mining interests of this kingdom, and through them contributed largely to the sources of national as well as individual wealth. Many invaluable seams of coal never could have been worked without the aid of such an instrument; and its long use throughout an extensive district, with the comparatively limited number of accidents, proves its claim to be considered, under ordinary circumstances, a Safety-lamp. The principles of its construction appear to have been practically known to the witnesses, Clanny and Stevenson, previously to the period when Davy brought his powerful mind to bear upon the subject, and produced an instrument which will hand down his name to the latest ages. 1664. 2588. 1334. 2224. 2236. 334. 340. 1537–1545. 1561. 1551.

The attention of Your Committee has been drawn by different witnesses to contingencies in mining, under which the lamp of Sir H. Davy ceases to afford adequate protection. Of the possible existence and nature of those contingencies, Your Committee have ascertained that the inventor was well aware, and they regret that the cautions he gave to some of his immediate friends were not made more public. Accidents have occurred where his lamp was in general and careful use; no one survived to tell the tale how these occurrences took place; conjecture supplied the want of positive knowledge most unsatisfactorily; but incidents are recorded which prove what must follow unreasonable testing of the security of that lamp; and Your Committee are constrained to believe, that ignorance and a false reliance upon its merits, in cases attended with unwarrantable risk, have led to disastrous consequences. The proofs collected in support of this opinion may be considered so many warnings to the miners of England. The prejudices which exist in many districts against the employment of the Davy-lamp are not occasioned by doubts of its protective character: the complaints made are of too little light, and the difficulty, in comparison with the use of the common candle, in bringing that light to bear with precision on the work, particularly in the thicker seams which are found in Warwickshire, Staffordshire and other counties. Notwithstanding these prejudices, Your Committee conceive that no employer of miners can be justified in allowing caprice, or inconvenience to certain individuals, to interfere with a due protection to the lives of his workpeople. In some mines, now lighted by the ordinary means, the use of the lamp ought, in the judgment of Your Committee, to be compelled by the owners. 1886. 2558. 2586. 818. 3833. 3960. 2226. 2737. 2941. 2942. 3446. 2562. 3247. 648. 2547. 2556. 2702. 1956. 2701. 3189. 1633. 1761. 1778. 2239. 2568. 2747. 470.

Many improvements, calculated to lessen the number of dangerous contingencies already alluded to, have been suggested; all these may be considered as extensions of the principle; such are the lamps produced by Messrs. Upton & Roberts, Mr. Newman, Mr. Martin, Mr. Douglas, Mr. Wood and Mr. Dillon. The lamps of Dr. Clanny and Mr. Ayres are provided with additional mechanical contrivances intended to exclude danger, which might overcome the safety-principle, and at once warn the miner of the insecurity of his situation, by the extinction of his light. All these are described in the Evidence, except Mr. W. Martin's; a drawing which accompanies will serve that object; and Mr. Ayres's, which is a suspended extinguisher, descending on the flame immediately 354. 371. 815. 821. 1032.

the gas inside the gauze is ignited; this lamp cannot be opened or interfered with, without producing such extinction. Your Committee have not ascertained how far the extinction of the lighted wick would also be accompanied by the extinction of the burning gas surrounding it.

4061. In the experiments made before Your Committee at the London University, it may possibly be remarked, that the tests applied were not such, in nature or mode of application, as the known actual condition of the Mines would point out as satisfactory. It must not be forgotten that the object of those experiments was to ascertain which, of all the lamps produced, was, when exposed to the severest trial, best entitled to the name of "a Safety-lamp." In these experiments the explosion of the gases within the lamp was effected in every one, and similar explosions produced externally, save Messrs. Upton & Roberts's. Your Committee are, therefore, decidedly convinced that its construction possesses paramount merit. Your Committee cannot admit that these experiments had any tendency to detract from the character of Sir H. Davy, or to disparage the fair value placed by himself upon his invention. The improvements are probably those which longer life and additional facts would have induced him to contemplate as desirable, and of which, had he not been the inventor, he might have become the patron. With the sole exception of unexpected destruction of the instrument, Messrs. Upton & Roberts's lamp appears to Your Committee to provide against all, or nearly all, the contingencies attending the Davy-lamp.

2229. 3481. 739. Mr. Buddle states, that tin shields, and a partial concealment of the lamp under their dress, constitute the prudential precautions taken by the miners in dangerous situations to prevent the flame passing the gauze when the lamp is agitated. The glass chamber does all this with greater certainty;

1903. 3319. 1897. 1048. its sudden fracture leaves the instrument a perfect lamp on Sir H. Davy's construction. The introduction of the glass is not new; the novelties are, the shape of the glass, the collar which regulates the admission of air

1923. 1945. 3096. or gas to the cotton wick, and the double tissue of gauze beneath the wick, which prevents firing backward. If no practical objections are

1941. 3963. discovered, and Your Committee do not contemplate any which may not be readily overcome, Messrs. Upton and Roberts's lamp will supply

800. a grand desideratum, especially if extensive experience should prove that the lamp and area of the gauze may be so increased as to allow of more light with safety.

On the necessity of having correct Maps and Plans, Your Committee have already reported. The long catalogue of casualties to which the miner is subject will be found detailed in the Evidence. Mr. Roberts, one of the witnesses, produced to Your Committee his Safety-hood, to enable persons to enter drains, wells and mines charged with carbonic acid gas. Your Committee report with pleasure their opinion of its great value, and of the merit of the inventor. The advantages to be

1833. 3521. 3545. obtained by having the safety-hood always ready for use are by no means hypothetical; interesting proofs of what may be effected by its use have been received, and the practicability of saving life after explo-

3529. sions, when no hope remained, has been demonstrated.

On a review of their labours, Your Committee cannot but feel apprehension that they have in great measure failed in devising adequate remedies for the painful calamities they have had to investigate; they entertain,

766. 775. notwithstanding, a sanguine expectation that the attention of the public will be availingly turned to this interesting subject. The aid they have received from many scientific and philanthropic characters in the course of this Inquiry, and the disinterested zeal the parties have manifested, war-

1813. 4131. 4166. rant these hopes. How far Legislative enactments might come fairly in aid of the miner has had the serious consideration of Your Committee. The great

great dissimilarity of the mineral stratifications of the kingdom, the constantly varying circumstances of particular Mines, render it in their opinion impossible, at present, to lay down any precise directions, or to form any rules of universal application. Your Committee agree with many intelligent witnesses, that great benefit might be fairly and sanguinely anticipated from men of known ability being encouraged to visit the Mines, whether in the character of distinguished chemists, mechanists or philanthropists. Your Committee are assured that these visits would be received with pleasure by the mine owners, and that every assistance in the way of experimenting would be promptly afforded. They retain a grateful recollection of the results which followed the visits of Sir Humphrey Davy.

1806. 1814. 4174. 2415. 2509. 2509.

On considering what may be due to the comfort and welfare of a class of men who, at great personal risk, contribute largely to the necessities, luxuries and wealth of this great Empire; the immense value of these mines to the community; the loss of life which has occurred, and the benefits which have already accrued from the labours and investigations of scientific characters; Your Committee have been disposed maturely to weigh the suggestions which have been made to them upon the necessity of having this inquiry continued in the mining districts, by competent individuals, acting under Authority. They are not insensible to the advantages which might result from such a proceeding; but many serious objections having been stated to the proposition, Your Committee conclude, under present circumstances, to abstain from giving an opinion upon the necessity or expediency of such a course.

2509.

Your Committee are glad to find that increasing attention is paid to the moral culture and education of the mining population. From the establishment of associations similar to the Polytechnic School recently formed in Cornwall, as named by one or more witnesses, and the opportunity thus afforded of cultivating native talents, great advantages may be anticipated. Whilst your Committee have, in the case just alluded to, had pleasing proof of the solicitude with which the welfare and safety of the miners are consulted in many places, they cannot express the sense they entertain of the responsibility incurred by the owners of Mines generally; in their hands are the lives of a vast multitude of their fellow-creatures, industriously contributing to their personal and our national aggrandizement. The dependence placed upon agents and managers is necessarily great, and doubtless, in many instances, from the characters of the individuals, justifiable. The number of subordinate overseers, under whatever name, ought never to be reduced on any pretence of economy; a vigilant oversight of these on the part of the owners, viewers or managers, as well as a determination to employ none in responsible stations who have not recommended themselves by long experience, skill, sobriety and habits of strict attention, may prevent many accidents. It is the bounden duty of these owners carefully and constantly to examine into the state of their Mines; if this is not personally practicable, they ought to call for written daily Reports from their subalterns, of every circumstance and event connected with the proper ventilation of the Mine. There will, however, still remain to be exercised that quick perception of cause and effect, that accurate adaptation of means to the end, that nice observation of various natural phenomena connected with the state of the atmosphere at the surface and under ground, upon which, it is obvious, safety must ultimately depend. Every possible exertion should be made, every effort employed to bring the workmen acquainted with their individual responsibilities, and those theories and principles, both as regards the lamps and proper ventilation, upon the observance of which their personal existence and that of their comrades are at stake.

222. 205. 3174. 1193. 1870. 3945. 1761. 2163. 2458. 3690. 538. 615. 737. 2233. 443. 1353. 1803. 2063. 2960. 3737. 1809. 1669. 1676. 1703. 2804. 3167. 3792. 783.

In conclusion, Your Committee regret that the results of this inquiry have not enabled them to lay before the House any particular plan, by which the accidents in question may be avoided with certainty, and in consequence no decisive recommendations are offered. They anticipate great advantages to the public and to humanity, from the circulation of the mass of valuable Evidence they have collected. They feel assured that science will avail itself of the information, if not for the first time obtained, yet now prominently exhibited; and that the parties for whose more immediate advantage the British Parliament undertook the inquiry, will not hesitate to place a generous construction on the motives and intentions of the Legislature.

1872. 1381. 1384. 776.

From the following individuals communications have been received by the Committee, and have received due attention.

Ayres, Mr., Newcastle-upon-Tyne.
Bernhardt, F. A., Mr., Southampton-row, London.
Bradley, Mr. J., Keighley.
Booth, Mr. D., London.
Barton, Mr. B., Blackburn.
Bishop, Mr. J. P., Blackfriars.
Chavasse, Mr. Jos., West Bromwich.
Clark, Mr. A., Nelson-terrace, City-road.
Collier, Mr. E. H., East India Cottage, City-road.
Dalton, Dr., Manchester.
Dunn, Mr. M., Newcastle.
Escrick, Mr., Sunderland.
Evans, Mr. John, Salford.
Ferguson, J., Esq., Rhuabon, Flint.
Fraser, Mr. J., Hackney-road.
Godwin, Mr. S., London.
Greenwood, Mr. W., Halifax.
Holton, Mr, J., Sunderland-bridge.
Hutton, Mr. M., Sunderland.
Jones, Mr. R., Salford.
Lawson, Mr. J., St. Helen's Auckland.
Lowrie, Mr. W., Sheldon, Durham.
Martin, Mr. W., Wallsend.
Milne, Mr. J., Edinburgh.
Murray, Mr. J., Edgeley, Stockport.
Mackenzie, Sir G. S., Coul Dingwall.
Menzies, Mr. M. E., Fludyer-street.
Pycroft, Mr. J., Derby.
Robson, Mr. G., Bolton.
Storey, Mr. T., St. Helen's Auckland.
Sopwith, Mr. T., London.
Slatey, B., Esq., Dee Bank.
Thorpe, Mr. R. S., Sunderland.
Taylor, Mr. G. R., Sunderland and Leicester.
Ward, Mr. E., Bedford.
Wawn, Mr. C. N., Newcastle-upon-Tyne.

4 *September* 1835.

MINUTES OF EVIDENCE.

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MINUTES OF EVIDENCE.

Mercurii, 17° *die Junii*, 1835.

JOSEPH PEASE, ESQUIRE, IN THE CHAIR.

Goldsworthy Gurney, Esq. called in; and Examined.

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1. WHAT is your profession?—My original profession was medicine; I have been more particularly engaged in mechanical and chemical pursuits during the last ten years of my life.

2. Are you acquainted with the mining districts of England, generally or locally?—I am more particularly acquainted with the mining districts of Cornwall, and of the western parts of England, than with those of the north.

3. You are aware of the fact, that the mining districts of the North of England particularly are annoyed by what is called fire-damp?—I am aware of it.

4. Are you acquainted with the nature of fire-damp?—It is a subject on which I have made extensive experiments; I have chemically investigated the composition of fire-damp often; I believe I am acquainted with most of the states of mixture and chemical composition, in which it is found in coal mines; I have analyzed also some of the fire-damp which is found in the Welch mines, which however is not extensive or dangerous. I believe I am acquainted with the nature of "fire-damp" generally.

5. Will you have the goodness to give to the Committee a simple definition of the nature of fire-damp?—Fire-damp is generally a mixture of carburetted hydrogen and atmospheric air; sometimes it contains a portion of free hydrogen, but most commonly it is atmospheric air and carburetted hydrogen, with pure hydrogen alone; this was the case in a Welch mixture which I examined. Often it is also adulterated with other gaseous mixtures; but those first stated form the principal.

6. In what state of mixture with the atmosphere do you consider it most explosive?—One in four is explosive; below that it is scarcely so; as it approaches to one proportion in nine it becomes more and more explosive. From the experiments I have made, I should say, that one in eight, or one in nine, is the most explosive mixture of carburetted hydrogen and atmospheric air.

7. In the course of your scientific researches, have you made any experiments for the purpose of determining the temperature at which explosive mixtures will take fire?—About 500 degrees of Fahrenheit; I made a long series of experiments with this view in 1822. The result of those experiments was certainly interesting. Practically I found that it required a body at a white heat to ignite a mixture similar to the fire-damp, when, in fact, the fire-damp requires only from 500 to 600 degrees of Fahrenheit. The reason why this difference exists arises from the circumstances under which the heat is applied. If a red heat, a red-hot iron for instance, which is about 800 degrees, be plunged into a certain quantity of fire-damp, the particles of gas pass so rapidly away from the heated body, as soon as they are a little warmed, in virtue of their change in specific gravity, as not individually or collectively to arrive at a sufficient temperature for ignition, viz. to that of 500 or 600 degrees; therefore a red heat applied to an explosive mixture of fire-damp will not ignite it: but if you place white-hot iron, under similar circumstances, into a vessel of explosive mixture, the particles, mixed in contact, cannot pass off before they arrive at 500 degrees, therefore it will instantly explode. The gas in the former instance moves so rapidly away as not to arrive at a sufficient temperature for combination; but if you confine the gas so that it cannot escape, and thus raise the heat of the whole to 500 or 550 degrees, it then will take fire.

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8. Under those circumstances, have you made many experiments with the wire gauze?—I made a great number of experiments about the same period, principally with a view of burning with safety, for the purpose of obtaining a powerful and intense heat, a mixture of oxygen and hydrogen gases, which is the most explosive mixture known.

9. That was at the same time with the experiments you have alluded to?—Yes, it was; those experiments, from their results, being new and unexpected, were carried to a great extent; I found that no kind of wire gauze, with any practical number of holes in a given surface, would prevent the passage of flame produced from such mixture under certain circumstances, or through the smallest possible tubes. This led me to make experiments on wire-gauze, as connected with the safety-lamp used in mines. The results of those experiments proved, that if an explosive mixture, such as is found in coal mines, was made to pass at the rate of about 300 feet a minute through the meshes, that the flame would pass the gauze, and inflame an explosive mixture on the opposite side; or if a wire-gauze lamp was made to pass or moved through an explosive atmosphere, at this rate (namely, 300 feet a minute, or faster), it would explode it; but, I found invariably, that if the wire-gauze and explosive atmosphere was steady, or if neither moved at a rate above that which I have stated, there was no explosion. If however they did move at this rate, or at a rate above it, that it then would explode. At a rate far less than this I could explode a mixture of pure hydrogen and atmospheric air, which however is seldom found in mines. This mixture may be exploded through "80-hole gauze:" the finest mesh. In further experiments with the wire-gauze lamp as a means of safety in mines, I found that if any inflammable matter was on the outside of the wire-gauze when burning in an explosive mixture, that the heat of the gauze would ignite that inflammable matter, which, arriving at a white heat, would ignite the explosive mixture on the opposite side, and thus produce explosion of the whole.

10. That is to say, that though the wire-gauze might not actually be white hot itself, that any foreign matter on the external surface of that wire-gauze might be heated to such a degree as to occasion explosion?—That is precisely my meaning. If in practice, for instance, a small piece of coal, a small portion of surphur, or any such inflammable matters which may be found in mines, was to fix itself on the outside of a safety-lamp, it would be raised to a red heat by the wire-gauze, which matter would, by the external atmosphere going to feed the flame within, be soon fanned or raised to a white heat, and thus communicate sudden explosion to the surrounding atmosphere. Some part of the wire-gauze of the lamp is generally at a red heat when fire-damp is burning within it.

11. Are you aware that in most of the coal formations there are particles of coal nearly resembling carbon?—I am not practically aware of it; I have heard it stated.

12. Those particles would be specifically lighter than what is called the complete formation of coal?—They would, and float in the atmosphere, depending entirely in degree upon their extent of surface; if we extend gold, which is one of the heaviest metals, we may make it so light as to move with or float in the atmosphere; and so the particle of coal, diminished in magnitude, or extended in particular form, would become so light as to float about.

13. Then any substance similar to common charcoal would be particularly liable to ignite under those circumstances?—I think it would: its arriving at a white heat on the outside of a safety-lamp would depend upon the current of air that was at the same time passing against it. Charcoal, unless it is exposed to a current of air, which feeds it with oxygen, remains at a red heat: in such a state it would not inflame fire-damp; but if a slight current of atmospheric air was to blow or impinge upon it, it would quickly arrive at a white heat, and then explode fire-damp.

14. You are aware of the invention of Sir Humphrey Davy, for the protection of the miner working in an impure atmosphere?—Yes.

15. What do you consider to be the rationale of that invention?—The rationale of Sir Humphrey Davy's safety-lamp is connected with the radiation of heat, which is so rapid from its surface that the temperature of the wire-gauze is so kept under as to prevent the passage of flame; or, in other words, to prevent combustion or ignition of the small portions of gas which happen to be within the interstices. You cannot, under ordinary circumstances, raise wire-gauze to above a red heat, consequently at that temperature an explosive atmosphere will not take fire, provided

vided that it be stationary, as I have before stated; but in case of a certain rate of motion, the flame is driven further into the interstices, and at length comes through, in time, and in danger proportioned to the mechanical force, governed by the rate of current.

16. Give the Committee your general opinion of the comparative safety of that lamp?—I think the lamp is perfectly safe if the atmosphere is kept tolerably steady, and there is no free hydrogen in the explosive mixture; but I think, if hydrogen is mixed with the atmosphere, then the lamp would not be safe, even under stationary circumstances: I think the lamp is safe in a carburetted hydrogen mixture, if at rest; but if moved at a rate of or exceeding 300 feet per minute, I do not think it would be safe. I cannot speak to the extent of practical danger arising from the facility to the wanton or careless exposure of the naked flame, which perhaps in practice is impossible to be prevented: I am fully aware that miners will take off the gauze to light their pipes, or to get more light, for at best it gives a feeble light through the wire-gauze, and they are strongly induced to take it off to get more light when at work.

17. Then it is no protection to a man at work, where there must always be a current of air?—I do not think it is a positive protection; I think it is a partial protection; I think that fire-damp might burn within it safely for a time under some circumstances, and give notice of a dangerous state of the atmosphere by the observed phenomena in such cases.

18. You are not aware, as not being a practical miner, whether it is or is not the habit of the miner to work for hours together with that lamp full of flame?—No; I do not of myself know it, I have heard it stated.

19. Was the lamp of which you speak surrounded by a glass chamber?—No.

20. Is it not frequently so constructed?—I understand it is now often so constructed.

21. Under those circumstances, what would be your opinion of its safety?—I think, if the glass is kept sound it will remove much of the danger of the lamp, but not all; there must be an inlet for air to feed, and an outlet for it to escape, from the lamp, which I do not see can be protected by glass.

22. Is your opinion against or in favour of Sir Humphrey Davy's lamp?—My private opinion, as I am asked it, is, that it is not practically safe; experimentally it is so, under the circumstances I have stated, but in practice I do not think it is.

23. Then upon the whole, as a matter of safety, you think it has been over-rated?—I think it has, so far as I have been informed upon the subject; I do not know to what extent it may or may not have been over-rated.

24. You have not had much experience of its practical effects; have you seen it in mines?—I have never seen it in mines.

25. But supposing the case of a lamp perfectly clean, the gas free from all foreign substance, and surrounded by a glass chamber, do you not conceive that many mines might be worked with comparative safety with such an instrument, in lieu of candles?—I think they might, certainly.

26. Are you aware of the construction of a lamp that was invented at the same time by Mr. George Stephenson, the architect?—I am aware of the fact, but I am not sufficiently aware of its construction to speak of it.

27. Was not that lamp protected by a glass chamber, in the same way as Sir Humphrey Davy's?—I do not know; there were various attempts about that time to effect a safety-lamp; some insulated the flame by passing air to feed it through water: I am not acquainted with the whole of them.

28. Do you think a miner, proceeding at his wonted pace to his work, carrying that lamp through a noxious atmosphere, would run the risk of igniting the atmosphere by which he is surrounded?—I think he would, at a walking pace, particularly if swinging his arms.

29. What proportions of gas would you consider most likely to produce such a result?—From one to seven, up to ten.

30. That is to say, one of atmospheric air, and seven to ten of carburetted hydrogen gas?—One to seven, up to ten, and the intermediate proportions.

31. Have you ever heard of the circumstance of the miners applying their mouths to the gauze to force the flame through the wire into their pipes?—I have often heard it stated.

32. Under such circumstances, could the lamp be any protection?—I think not; I think the facts I have stated show that it cannot be safe under such circumstances; for, as danger depends upon the mechanical force given to the flame,

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whether it is produced in that way, or by the natural current, I think it matters little.

33. Have you ever made any experiments which will tend to show how long wire-gauze of 80-hole would bear a flame of carburetted hydrogen, without being decomposed?—It does not oxydize very fast.

34. Are you speaking of common wire?—Copper wire.

35. Are those lamps generally made of copper wire?—I believe they are generally made of iron; some that I have seen were made of brass wire, and some of copper.

36. Are you aware whether it was any part of Sir Humphrey Davy's view or intention that that gauze, to be complete, should be made of platina?—At this moment I do not recollect, but I think not. Platina is a comparatively bad conductor of heat, and therefore would increase the danger. It is a fact well known to the scientific chemist, that by the flame of the mixed gases, which give the most intense heat known, that he can fuse platina, when he cannot fuse copper, though the first requires five times the heat that the other does, occasioned by its non-conducting or imperfectly-conducting property; therefore the masses of wire-gauze made of platina would be more likely to come to a white heat sooner than that of iron or copper.

37. Have you ever understood that it was Sir Humphrey Davy's intention that that lamp should be made of platina?—I never heard him say so.

38. Was it not the case that he introduced an improvement into the safety-lamp, consisting of having a small web of platina wire in the interior of the lamp, for the purpose of retaining lustre at a white heat at the time that the light itself had been extinguished?—Yes, I am aware of this; in this case a platina wire, made into a coil, is placed in the lamp, which platina wire is always white hot by the flame; but if the flame of the lamp is extinguished by the burning of the explosive mixture, the platina wire continues white hot in virtue of its decomposing rapidly the fire-damp; on the admission of pure air it remains sufficiently hot to light the lamp again, and for this purpose principally it is introduced.

39. Do you consider Sir Humphrey Davy's lamp so far complicated in its structure as that miners, or persons of that class, may possibly, from ignorance or misapplication of it, be frequently subject to accident?—I think the construction of the lamp is very simple; but as the miner can, I believe, at his pleasure, unscrew, or by other means expose the naked flame, the lamp may thus be rendered useless.

40. May it be rendered useless and at the same time dangerous?—Yes; if such exposure was to occur in an explosive atmosphere, an explosion would instantly happen.

41. Is it frequently necessary for the miner to loosen and tighten the screw, and make such changes in the state of the flame in the lamp?—No, he need not open it all; there is a provision by which he can trim his light without opening it; therefore he need not open his lamp for this or any other purpose that I am aware of.

42. Are those directions very simple, such as any common man may comprehend?—Yes, self evident.

43. Therefore it must be his own actual carelessness if accident does occur?—Yes, if by the exposure of the flame. It is possible a miner might accidentally strike his lamp against any part of the mine, and break the wire-gauze, or a piece of coal in working might fly against it and break the lamp; such accidents might occur; but I believe miners will open their lamps. It is said they pick them when locked.

44. But it is not necessary to do that in order to trim them?—Certainly not.

45. And then they can trim them with perfect safety?—Yes.

46. What length of time have those lamps now been employed in mines?—I think more than 20 years.

47. Have you published the experiments to which you alluded made with wire-gauze, and with explosive mixtures of gas?—Yes; most of them were published in 1823.

48. Not as a separate publication?—No; the experiments on wire-gauze were connected with my experiments to render the combustion of the mixed oxygen and hydrogen gases safe.

49. Will you be so good as to give the Committee the names and titles under which the works appeared before the public?—I think all the experiments on wire-gauze are to be found in my lectures.

50. Will

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50. Will you give the title of the work as it stands on the title page of the book?—"Gurney's Lectures on the Elements of Chemical Science," 1823, published by Messrs. Whittaker.

51. Have those experiments, to your knowledge, been repeated by any scientific men?—Yes; they have been repeated privately by many scientific men, and I believe they were publicly repeated at Edinburgh in 1824.

52. By whom?—I do not recollect at this moment.

53. Were they published?—I do not think they were published.

54. Were those experiments repeated privately, or before any part of the University of Edinburgh?—I think they were made publicly.

55. Were those experiments repeated during the lifetime of Sir Humphrey Davy?—Yes.

56. Have you any means of knowing whether he was acquainted with the result of those experiments?—From some circumstances which came to my knowledge I should say he was.

57. You doubtless were personally acquainted with Sir Humphrey Davy?—I was.

58. Have you ever had any conversation with him upon his lamp?—Yes; I stated to him the results of the experiments which I had made with wire-gauze.

59. Did you give him to understand your doubts as to the practical utility of that lamp?—I merely stated the experiments; the doubts regarding the practical utility were self-evident.

60. Have you any reason to believe, from any work extant of Sir Humphrey Davy's, that his views underwent any modification during his life-time?—I have had no opportunity of knowing.

61. Have your views on these subjects ever been controverted in print?—Not my views; the work containing them was generally noticed in the reviews and scientific journals of the day, some for, and some against, as is generally the case with works of such kind. In one particular journal it was very severely reviewed, in which every part of the book was minutely picked to pieces, and every typical error noticed, but the experiments on wire-gauze were passed over. In the same work my proposition for applying the light from lime to light-houses, now about to be used, was noticed so as to throw discredit on the experiments generally; but those on wire-gauze were not once alluded to; it therefore is possible, my views were not considered, by the reviewer, as worthy to be controverted.

62. You allude to the book that was published by Messrs. Whittaker?—Yes.

63. Is there any particular odour or smell that warns the miner of the existence of the pernicious gases?—I am not sufficiently practically acquainted to know what happens in mines, but I should think there is; the smell of carburetted hydrogen, and also of hydrogen, is very strong, and therefore I suspect may be detected by the smell.

64. Are you aware, that were there is danger in the mine, the flame of the candle becomes lengthened?—Yes; and the same happens with the flame in the safety-lamp.

65. Are you at all aware of the appearances which a light assumes when exposed to the mixture of carburetted hydrogen and atmospheric air?—The flame in the wire-gauze becomes lengthened, and the same thing happens with the naked light.

66. Are you aware whether the repetition of those experiments, by scientific characters in other parts of this nation, was attended with similar results with your own?—If made in the same way, the results must have been the same.

67. Was there anything peculiar in the mode in which those experiments were conducted?—Yes; they were made with a view to ascertain the effect of mechanical currents; this point, I suspected, was the dangerous one, connected with fire-damp and the wire-gauze lamp; and under those circumstances an apparatus was made which occasioned any rate of current, from one foot up to 500 or 600 feet a minute: the explosive mixtures, with a wire-gauze lamp, was placed in those currents so as to determine the extent of safety.

68. Was the value of the instrument so used ever acknowledged by the public?—I had the honour to receive from the Duke of Sussex a commemorative gold medal; it was likewise publicly acknowledged in several publications of the day; in the reviews I have alluded to.

69. How came you, as a scientific man, having come to the conclusion that Sir Humphrey Davy's lamp was not that sure protection which it had been understood

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to be, and which it was conceived as being, not to publish your views clearly and concisely to the world?—Impressed with the importance of the fact, and feeling that dangers did exist with regard to the lamp, and feeling that life was at stake, I thought it my duty to publish it in the most public manner that I could devise; I therefore did not publish it in any scientific work, which possibly might be read only by the few, but I published it in the "Times" newspaper in June or July 1824; I there stated the circumstances upon which I apprehended that the lamp could not be safe in mines; that mode I conceived would give it more publicity than if it was published in a scientific work, which but few persons would read.

70. Did the article appear with your own personal signature?—Yes.

71. Can you tell the Committee the exact date of that?—No, I cannot state the precise date, but if it is important I will find the paper; it is now 10 or 12 years since.

72. Did it occasion any discussion in the newspaper?—It occasioned a discussion in some of the institutions.

73. Did it occasion any reply in the newspaper by Sir Humphrey Davy?—No.

74. Was that before his death?—It was.

75. Was there any public refutation of your experiments, or an attempt to refute the deductions?—Never.

76. Can you suggest to the Committee any means by which the ignorant miner may be at once warned of the danger of his situation, as resulting from the noxious state of the atmosphere in which he is working, or about to work?—It requires consideration; at this moment I can state only the lengthened flame; I believe, however, miners may discover by the odour where they have noxious vapours.

77. Has it ever occurred to you to consider whether mines might be lit under such circumstances as to do away with the necessity of the moveable lamp?—The subject has been one which I have lately considered a good deal, in consequence of being engaged again in experiments of a similar kind to those of 1822; I have recently made a series of experiments for the Trinity House, on artificial light; and the results of these experiments, and observations connected with them, induce me to believe it possible to light coal mines without taking flame at all into mines: in a few words, I will state, that I think it capable of being done by reflected light. In these experiments I found artificial light may be produced, so intense, that when placed in the focus of a parabolical reflector, it will throw a distinct shadow at the distance of 11 miles. Now, as light is capable of being concentrated, reflected and refracted in any angles, or in any direction, or in any quantities, I think it possible that such light may be reflected into mines, subdivided, and passed through the galleries, in sufficient quantities and intensity as to enable miners to work far better than by lamps of any description. The light itself, and the combustion to produce it, could be placed above the shaft, in the open air. If, however, from mechanical difficulties, such as obstructing parts in the way of its passage down the shaft, it is possible that the light might be placed in some safe part of the mine itself, where fire-damp is never found, and from thence be reflected and refracted through the various parts of the mine. I have made experiments with this view, and have found light capable of being reflected, in various directions, with simple and inexpensive reflectors; the first reflection requires a true parabolic reflector, but afterwards plain and simple surfaces will do. Possibly, the whole mine and galleries may be all lit by a single light, if not very extensive; but if seven lights of the first order be placed in the focus of seven true 12-inch parabolas, and arranged within a circle of 3 feet diameter, which they may be, I firmly believe one of the longest mines might be most effectually lighted in every gallery. No one can judge of the power and management of this light who has not seen it, or possibly conceive its practicability to the subject before us. I need not go into explanation of the manner of doing it. The Committee will remember that, as the angle of reflection is always equal to the angle of incidence, we may throw the light in whatever direction we please; by this means we may turn it round a corner at right angles, or in any angles suited to the drifts the mine happens to be cut into. The practical difficulties connected with this plan chiefly, I conceive, are those arising from obstructions in the galleries: one, for instance, is the air doors, which are necessarily used for ventilation: there is no difficulty, however, in such case in placing a piece of plate glass in some particular part of the door, so as to admit the passage of the light through it, or a second light may be brought in an opposite direction; again, if the galleries are so low that there is not room for the light, coal waggons or miners, to pass together, it is possible so to widen

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widen them, or enlarge them, that there would be a sufficient space for a sufficient quantity of light to pass; it may be passed through very small openings by strong concentration, and afterwards diverged as may be necessary.

78. Would it not be attended with great expense?—No.

79. Less than the ordinary mode?—I am not prepared to say exactly, but I think it would not be more expensive than the present mode. In case the light is not required to be very great, I think a light of less intensity might be used, with advantage, that would be less expensive than the present oil lamps. A very simple but powerful light is about to be adopted by the Trinity Board for light-houses, which, by way of distinction, and in reference to the place where it was discovered, has been called the "Bude Light." This light produces an intensity of 140 times that of the present Argand burner; this light therefore may be used where the ramifications of the mine, or greater extent, does not require the first order, namely, the lime light. In some cases the light from the common Argand burner, placed in a parabolic reflector, may be sufficient, and in that case it certainly would be cheaper. I am of opinion, from the experiments and investigations made at the Trinity House, that the light from lime, and also the Bude Light, is less expensive than that of the ordinary light, taking quantity and intensity into account, which may be sub-divided to equal intensity with the first; the intensity of the one is 290 times greater than the other, and the intensity of the second 140; thus one is capable of giving the same quantity as 290 Argand burners, and the other as much as 140.

80. The term Bude Light has no application to the peculiar manner in which it is produced?—It is a term simply used to distinguish it.

81. From what is it derived?—I fear that my answer would be a tedious one if I go into a full description. It is produced by striking nacent carbon, evolved in the combustion of oil, resin, or similar bodies, with oxygen gas.

82. You have spoken of difficulties in the introduction of this new system of lighting in the mines of this country; apply your mind for a moment to the difficulties which might arise in the mines not having above two feet or three feet depth of seam?—I think such difficulties are to be overcome by inexpensive boring or widening to admit the light to pass; in such a drift a stream of light, highly concentrated, of six inches diameter would be ample, and whether it passed by the side or the top of the gallery it matters not. A large quantity of light, by simple means, might be concentrated in such case, and passed along such an opening, and afterwards diverged in larger galleries, if such was indispensable. These are points upon which I think the Committee will find other persons more capable of giving information on than myself.

83. Supposing a light is required to be in a straight line for a mile, there would be no difficulty in obtaining a sufficient light at the terminus?—The light at the distance of a mile would enable you to read the smallest print. If it is reflected two or three times in that distance through a circuitous passage you would lose very little, if you use good reflectors made of speculam metal. The quantity of light lost by such reflection is very trifling.

84. The question related to the casting of light upon one object at the distance named?—So I have answered it; it is of little consequence whether it be straight a head, or at the end of a curved or angular gallery.

85. In case that light is then to be divided into 50 different directions, so as to suit different galleries, what would be the consequence as regards the terminus?—The result would be, that the light would simply be reduced 50 times in quantity; it would be divided into 50 portions; it would then be still stronger than the strongest Argand burners; and I beg to be understood as meaning the Argand burner used on the tables of private families, not the little oil burner of the safety-lamp. I will make an observation here which may be important, namely, the stream of light may be sent through the various galleries, and when it arrives at the situation where the men are working, every man, with a little reflector or refractor, as may be determined on, may take that portion of light which may be intended for him, and no more, from the great stream, and thus limit him the quantity of light that he may abstract from the stream; which portion he may at pleasure direct wherever he pleases on the work before him; so that instead of a lamp, he would work with a little diverging reflector, or refractor, which he would carry in his pocket, perhaps of the size of half-a-crown.

86. Do you not think that the experiments of scientific men might be better made in the mines themselves than they could be in their own laboratory?—Certainly;

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tainly; if a principle is established, it rests as a matter of mechanical detail or of mechanical situation and position, to know whether it can or cannot be applied, practically, with advantage. Sir George Cayley informs me that he used the principle of reflection to throw day-light to some men who were working a deep well. It had a beautiful effect, and answered the purpose perfectly. His reflector was nothing more than a piece of tin plate. The day-light is not sufficiently intense; we cannot focus it so as to be passed through the galleries of mines.

87. In your opinion, would the experiment be better conducted by placing the light above the shaft, or at the bottom of the shaft?—It would depend on the depth and size of the shaft.

88. Assume 200 yards in depth?—In such case above; you get at the materials and apparatus for forming the light better; the distance of 200 yards has very little effect in diminishing the light; reflected light does not obey the same laws as radiated light; radiated light diminishes as the squares of the distances, but reflected light does not; this is contrary to received opinions, but I am satisfied it is correct, from the observations I have lately made.

89. You have not supposed any difficulties in the application of this light, beyond those already stated, which the Committee understand to be the interruptions occasioned by stoppings or trap-doors in the mines, or the extreme subdivision of the reflected light?—I have: there are others, but I think of minor importance, which can only be justly appreciated in practice.

90. The shafts of the mines are placed at right angles, that is, they are driven along, and they begin at the further end, and then work upwards; is there any difficulty in transmitting the light at right angles?—Not any difficulty whatever; you may transmit the light in any angle you please; it may first be thrown down a shaft, and then sent into any angle, upwards or downwards, or on one side or on another.

91. Suppose there be a space of two or three feet left on one side, or both sides, of the carriages conveying the minerals along the galleries, the light might be transmitted independently of the space occupied by the carriages?—Certainly.

92. Or through a similar space above the carriages?—Yes.

93. And you propose, to obviate the difficulty of passing through the trap-doors, that means in the mines, by the insertion of glass in those doors; what is the smallest size you would consider sufficient for that purpose?—It would depend upon the situation in which the door was placed in the mine; if in the first gallery, where you wanted the full stream or supply of light to pass, you would require 20 inches diameter; when doors occur further on, in the division of light, perhaps three or four inches diameter would be sufficient.

94. Would that be sufficient to light a gallery at the distance beyond the door many hundred yards, if 12 feet wide?—Certainly. There is another valuable natural fact that I would mention here: the stream of light, as it passes through the air, is refracted by the atmosphere, and thrown in all directions several yards, with an intensity sufficient for practical purposes. My house at Bude has a long gallery in it; I passed a stream of reflected light through that gallery; every bed-room entering into the gallery was sufficiently illuminated in every part for a person to pick up a pin. The light in the bed-rooms was refracted light, from the reflected light passing through the gallery. I conceive that unless men are working at some distance from the stream of light through a gallery a reflector would be scarcely necessary for them. Dust, floating in the atmosphere, reflects a good deal of light sideways.

95. Would the accumulation of dust upon glass so inserted in one of the trap-doors, be a serious impediment to the light?—Not practically, because it could be easily wiped away.

96. Are you aware that a boy is generally stationed to take charge of those doors?—Yes.

97. And of course, he might have instructions to keep the glass perfectly clean?—Certainly.

98. Are you aware of many accidents having occurred in and about mines from the explosion of steam-engine boilers?—Yes; I have heard of several.

99. Those accidents have been of a very fatal description in the county of Cornwall frequently, have they not?—Lives, I believe, are sometimes lost; I am not aware of the extent to which explosion has happened.

100. Have any of those accidents come under your own personal observation?—Yes.

101. Will you state to the Committee your conception of the causes that led to those explosions?—My impression is, that in every case where a boiler has burst, there has been a want of sufficient water in it. From want of water the sides have become heated to excess; when water is reduced too low in a boiler, the upper parts of the vessel become hot; if at this moment a call is made for steam, which is dissolved in that remaining in its disengagement, it throws up water in the form of froth or bubbles, like the water which is expelled on taking a cork out of a bottle of soda-water. The water thus coming in contact with the heated sides of the vessel, instantly flashes into an unusual quantity of elastic steam: the pressure of it explodes the boiler, notwithstanding a safety-valve of more than ordinary dimensions may be placed upon it at the time: I would illustrate my meaning by the rationale of the bursting of a gun barrel: the whole area of the gun may be considered as the size of a safety-valve, and the charge of shot may be considered as the valve loaded, (which, perhaps, is about an ounce to a square inch); the quantity of elastic matter which is suddenly formed by the explosion of the gunpowder, though it may escape through the full diameter of the bore under a pressure of an ounce to the inch, frequently bursts the strongest barrels. So also steam, which is similar elastic matter, suddenly formed in a boiler, notwithstanding the safety-valve may be almost equal to the area of the boiler itself, would burst it. In illustration, I would state a circumstance which once came under my notice, where an open boiler was burst by steam pressure. The accident happened in consequence of gelatinous matter in the water, forming a film or blister, which prevented the contact of the water at the under part of the boiler; it consequently became red hot, when the film or bubble burst, and the sudden formation of steam burst out the bottom of the boiler, threw the water in all directions, and killed two men. The rapid or sudden formation, therefore, of elastic matter, will be sufficient to burst a boiler in ordinary working. If the steam is kept within the boiler, and any portion of the boiler becomes intensely hot, instantly that the water bubbles up or comes in contact with the heated sides, or mixed with the super-heated steam, it forms suddenly in sufficient quantity as to rupture the strongest boiler. If the question was put with an idea that the decomposition of water into its elements, or the separation of hydrogen gas, caused explosion of boilers, I beg to state, that my observations do not lead me to conceive an accident to happen from such a cause. I have often burst myself vessels experimentally, from the ebullition of steam, or rather the ebullition of water from the escape of steam against heated sides.

102. In the many numerous and curious experiments which you have made, as an improver of locomotive carriages, is this theory confirmed?—It has been confirmed in practice, so far as I have seen.

103. Have you any simple suggestion to make as regards the construction of steam-engine boilers, which might obviate the risk of such accidents?—The great points to be particularly studied to effect safety, is a perfect circulation of water, when in sufficient quantities, so that every part of the boiler may be kept at the temperature of the water; next, a provision that the quantity of water shall never be reduced below a certain level in the boiler. The division of boilers into small chambers, so that if the explosion should happen, under the best protection, would considerably add to personal safety; in short, amount to perfect safety.

104. Do you consider that the simple formation of a kind of inner boiler, surrounded by water, would entirely obviate that risk?—Certainly; while the water is on the outside; for whether it be outside or inside the plates it matters not, the temperature of the plates could never get above 212 degrees, or whatever the pressure of steam might require.

105. As that mode must be expensive, have you any more simple suggestions as to the construction of boilers?—The construction of tube boilers, which I have used for the last ten years, I conceive to be perfectly simple, perfectly safe, and capable of raising any quantity of steam. They are certainly now receiving the favourable opinion of practical engineers. I do not think there is any possible danger of explosion with them. I feel delicacy in speaking of this arrangement of boilers; I possibly am an interested witness; though unfortunately I have little interest now, as my patent is nearly out.

106. Upon the construction, at which you have just hinted, what area of boiler is required for a Bolton & Watt 20-horse power condensing engine?—No vessel forming a part of that boiler need be more than eight inches in diameter, the largest part; the extent of surface may be increased to any quantity at pleasure.

107. And the whole area for water and steam, in cubic feet, would be how much?—

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much?—That would depend upon the number of vessels used; you may multiply them to any extent you please; no single vessel need be more than eight inches in diameter.

108. What is your favourite theory as to the number of vessels for a 20-horse engine?—About 20.

109. But supposing the public not prepared immediately to adopt such a boiler, what do you conceive to be the most simple alteration of the boiler now generally in use, with a view of obviating such explosions as have been already named?—Some "tell tale," or provision, in the boiler, which alarms, by a certain sign, the "stoker" (as he is called) to a certainty of the too great descent, or waste of water in the boiler; that is, whenever it might get to a dangerous point of evaporation, there should be some plan for giving him intelligence by the part itself. I think there is no better plan than that of placing a piece of lead, or some fusible metal, at a particular spot, below which the water should not descend; so constructed, that as the temperature rises in the boiler, and mischief threatened, that lead would melt, and steam would escape, and be made to act as a safeguard itself, or to give a sufficient timely notice.

110. Are you aware, that so violent may be that ebullition in the boiler, in certain circumstances, that that fusion does not take place which might be theoretically supposed?—If the ebullition takes place sufficiently violent to keep the temperature of the plates of which the boilers are formed to the temperature of the steam, I conceive that no accident can possibly occur; but if it should fall, then the fusible metal would melt before the temperature would arrive at a red heat, or to a dangerous temperature: by alloys of metal you may make them fuse at any point of temperature, you may make them fuse at that of boiling water; at 300, 400, 500, 600, or any degree of heat you please; I am not supposing fusible metal to be a security in case there should be a sudden formation of steam; in that case, as I have explained, no sized safety-valve or any opening would secure it. The provision of such, with suitable arrangements connected with it, would certainly give timely alarm, and bursting or other mischief might then be prevented.

111. You are aware that it is the practice in mines to work several boilers in connection?—Engineers work them sometimes in connection and sometimes separate; they generally have more than one boiler to the same engine; whether they work more than one will depend upon the work they have to do.

112. Under those circumstances, is not the risk of explosion in any one particular boiler considerably increased by the alternations that are taking place among those boilers?—If there is not a free communication for water to keep its level in all the boilers alike, I think it would be so; if there is not a free communication between the boilers I think they are all liable to accident; the comparative state of fire under one boiler is possible to raise in it an excess of steam more than in another; unless therefore there is a free and perfect communication between all, the pressure may slightly increase in one boiler and drive the water from it to other boilers; such boiler would certainly get hot, and upon the ebullition or return of the water would burst.

113. Are you aware that many mines are extensively worked by the agency of gunpowder?—I am aware that gunpowder is used for blasting the mineral or coal, whatever the mine may be worked for.

114. Are not those parts of the work frequently attended by loss of life and sudden explosion?—They are; sometimes from the parts of the strata being perhaps blown away and falling upon the men, and sometimes from a premature explosion, but I do not think they are frequent.

115. Have you any suggestions to make to the Committee which would obviate the danger, incident from that mode of working, to the miners?—I have never considered the subject, except as regards coal mines, where gunpowder is essentially necessary, as stated by some, to be used for the blasting of coals and fire-damp, at the same time present. Under those circumstances, I have reason to think gunpowder may be safely used by a peculiar modification.

116. Are you of opinion that the ordinary use of gunpowder in an ill-ventilated mine would be unwarrantable?—The use of gunpowder, as now practised, would most unquestionably.

117. Are there any modifications which suggest themselves to you, as a scientific man, under which gunpowder might be rendered available for the labour of the miner under those circumstances?—I think it is possible; I will consider the subject further; it is a delicate question to give an answer upon.

118. Are

118. Are you of opinion that the adoption of the principle of percussion for ignition might, under certain modifications, be compatible with the safety of the miner?—There are some interesting and peculiar facts connected with the laws and influence of percussion as affecting flame, and the ignition of explosive mixtures of gaseous bodies, which I have particularly observed in experiments on this subject. I however beg time to consider my answer to this question, as it appears too important to be given without a repetition of the experiments, and reference to notes.

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John Taylor, Esq., called in; and Examined.

119. ARE you a civil engineer, and extensively connected with the mining of this kingdom?—My business is entirely confined to mining.

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120. Where is your residence?—In London, in Bedford-row.

121. Are you acquainted with the mining districts of the north of England?—Not the collieries of the north of England, but I am with the lead mines of the north. I should state, that my acquaintance with collieries is very limited.

122. Will you state to the Committee the casualties to which the operative miner is, in your opinion, exposed?—I should place first the destruction of life by the explosion of fire-damp in the collieries, which would form, I think, a very large proportion of the number of casualties connected with mining. Next, I think the use of gunpowder, in which I believe now the destruction of life is not very great; then the accidents arising from the great depth to which our mines are carried, from the men going up and down, and the casualties that must be expected from that circumstance. Then lastly, the bursting of steam-boilers has occasioned some loss of life, but in the mines of Cornwall to a very small extent, in my opinion.

123. As a general opinion, do you consider that the mines in the west of England, particularly in Cornwall, are well and wholesomely ventilated?—I think they are perfectly well ventilated; indeed it would be impossible to work them if they were not so; a mine ceasing to be ventilated ceases to be worked, as it is impossible to carry light into the gas which pervades our mines, in such circumstances.

124. What means are usually adopted for the purpose of ventilating the mines of Cornwall?—The means are simple; the application of a greater number of shafts than are usual in the collieries, and a communication from shaft to shaft by the different levels or galleries. If those communications are properly made, currents are found to set in different directions, varying, I believe, according to the temperature of the atmosphere on the surface, and the known increased temperature at considerable depths under ground.

125. Do any of your shafts proceed to a great depth perpendicularly?—The greatest depth, I believe, of any in Great Britain, is as deep as about 265 fathoms; we have one shaft of that depth at the Consolidated Mines.

126. Where is that mine situate?—In the parish of Gwennap, between Truro and Redruth, the great mining district of that country.

127. What is the area of a mine shaft?—Our shafts are generally square, or rather parallelograms, about 12 by 8; that shaft may be 14 by 10.

128. Is that shaft divided by a compartment or bratice?—Though we are accustomed to speak of it as one shaft, we sometimes sink two near together, which is the case in this instance.

129. The one becomes your down-cast and the other your up-cast shaft?—Not exactly; these shafts are so close together that they may be considered to act as one shaft, but there will be a great number of other shafts at the distance of 100 or 150 fathoms from each other.

130. Are not those shafts divided by wood, as partitions?—Wood is used for the convenience of the pump-work in the engine shaft; the shaft through which the minerals are drawn is not at all divided, it is open from top to bottom.

131. Is the Committee to understand that you are in the habit of sinking additional shafts for the purpose of circulation?—Not for that purpose merely, because we use them for drawing shafts, the transport being more difficult in our mines than in collieries. We employ a greater number of shafts.

132. Have you subterranean shafts communicating to different levels, called winzes?—Yes, we have.

133. Those are principally for the purpose of giving air?—For the purpose of examining

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examining the vein, and giving air to all the workings. I am sorry I cannot state to the Committee the number of shafts at the Consolidated Mines, but I think they extend, including the winzes, to more than 12 miles of perpendicular depth, and I believe the horizontal galleries to more than 40.

134. And those the Committee understand are nearly all in communication one with the other?—They all communicate. There will be always some that are in progress, and not yet communicated.

135. You are speaking of a copper mine?—Yes.

136. But, as intimately connected with mining, cannot you suppose a case in which a considerable period must elapse after the completing of one shaft before it becomes expedient on the part of the owners to sink a second?—Certainly; but we consider it the great duty of the directors of mines to foresee all such circumstances, and we consider it the worst management possible to delay the sinking of shafts to a period that would become inconvenient. I look upon that kind of foresight to be the great improvement of modern mining.

137. That is, according to modern practice, you would avail yourselves of the shafts hereafter expected to be wanted, for the purpose of immediate ventilation? - Certainly.

138. They begin to sink them before they are wanted?—Yes.

139. The distance at which those shafts will be separated from each other will depend upon the nature of the lodes and the difficulty of the subterranean transportation of material?—Very much, the recent practice is, to place the shafts at a greater distance from each other than formerly, because we have better mechanical means of ventilation, and better mechanical means of transport, and therefore we do not want so many shafts now as were supposed formerly to be necessary.

140. Then by immediately working up to a certain extent, on your ulterior plan, you obviate the necessity of perfecting your ventilation at one shaft?—Yes.

141. Under those circumstances, you are seldom under the necessity of adopting furnaces, blowing engines, fans, or other mechanical means known to scientific men?—We never use them but in such cases as where a level is in progress to communicate with a shaft, and then it may be necessary to resort to some of those expedients, otherwise they are not required.

142. You spoke of the impossibility of carrying on a work in an ill-ventilated mine; will you describe to the Committee what you call an ill-ventilated mine to that extent?—I mean by that to say, that the air becomes so vitiated that candles will no longer burn. Men can indeed live when light cannot be sustained, but it would be impossible to continue to work a mine in that state, and therefore ventilation must be had recourse to.

143. Is it or not the fact that many mines are working with the atmosphere in so vitiated a state, that the light becomes imperfect, and the health of the men injured?—Certain parts of the mines are in that state until communications are made, and while they are making, but such parts are not numerous.

144. You do not think that any unreasonable anxiety to save expense leads the masters to place their men in situations in which they ought not to be placed?—I do not, because it would be against the interests of the masters to do so.

145. What is your general opinion of the health and longevity of the mining population of Cornwall, as compared with the other laborious classes in the vicinity?—I think the health of the miners in Cornwall has improved in the period I have known them, which is for 36 years.

146. To what do you attribute that general improvement of the health of the mining population in Cornwall?—In some degree to a better state of ventilation, to more general comfort in the mode of living among the men themselves, and to a habit of taking some sustenance under ground, which they did not use to do; I think they worked too long fasting formerly.

147. What is the general average of hours in which the miners remain below ground?—Eight hours.

148. At what time do they commence work generally in the morning?—They take it in three regular corps or shifts, from six in the morning till two in the afternoon; from two till ten; from ten again till six.

149. Then the work is continuous throughout the 24 hours?—Yes.

150. In some cases do not the men work for shorter periods when the air is bad, and where it is very wet?—At the bottom of deep shafts, where the men are exposed to wet, they work for six hours; and there are some cases where the men work for 12 hours, but that is at their own choice.

151. Do you draw any particular distinction between the salubrity of mines for obtaining different descriptions of minerals?—I think not; the salubrity of mines depends much upon the good state of the ventilation; I recollect that when we commenced re-working the Consolidated Mines sixteen years ago, we found the passages in the old works very narrow, the communications not completely made, and I observed an unhealthy appearance among the men; in five or six years afterwards I observed a striking amelioration in the appearance of the men, and I understand from the agents and the medical attendant that such an improvement had taken place.

152. Was it not supposed some years since that the working of copper mines was much more prejudicial to health than the working of any other mines?—No, I never observed that; I have considerable experience in lead mines and tin mines, but I know of no difference in the health of the men. There is one fact which is very remarkable, which has attracted the attention of the scientific world; we are indebted to Mr. Fox for some curious experiments upon the subject; I mean the increasing temperature of the earth at great depths; we begin to find in our very deep mines some effect upon the health of the men from that cause, and to work in a constant temperature of 90 is likely to try constitutions which are not very strong.

153. Of course that applies to some very peculiar cases?—I believe that it begins to be admitted that as you increase in depth the temperature is clearly increasing also.

154. Is it in your power to place the Committee in possession of the results of those experiments?—I have no doubt that it is; I believe they are published in the Transactions of the Royal Society, but I will look them out and prepare myself with some abstracts; they have engaged the attention of the British Association, and I am one of a committee for carrying on experiments on a more extensive scale.

155. Have they appeared in a mining journal?—I think not; they are to be found in the Philosophical Magazine; some similar experiments have been made in a colliery near Sunderland, by my friend, Professor Phillips, of York, and I understood from him that he found Mr. Fox's observations generally borne out.

156. At what depth is that?—I believe nearly the depth of the shaft in which Mr. Phillips made his observation, which was about 260 fathoms.

157. Have you visited the lead mines in the county of Durham?—I regularly visit those at Alston Moor every year; I have the honour of superintending those mines for the Greenwich Hospital.

158. Are any females employed in the mines in Cornwall?—On the surface many, but none below.

159. Do you employ many young persons?—On the surface considerable numbers; and lads, from 12 years and upwards, underground; they are generally very healthy.

160. A considerable portion of the lads in the neighbourhood are so employed?—Yes; and girls from a very early age.

161. What age?—I believe children begin to work at six and seven years on the surface, picking the ores; very light labour.

162. For what hours are those girls so employed?—From seven in the morning till five, stopping in the middle of the day for dinner, but the elder girls generally work by contract, and therefore work sometimes rather longer.

163. The boys who are employed in the mines seldom go to that work prior to being twelve years of age, do they?—Seldom, I should think, unless they are very strong; they generally work with their fathers or brothers.

164. In speaking of the accidents from gunpowder, have any improvements been recently made in the mode of applying gunpowder to blasting in Cornwall?—Yes; I think two or three important ones.

165. Have the goodness to describe the former practice and the present?—The blowing rock by gunpowder is a simple process; the hole is bored into the rock, and in such direction as to expose the weakest part to the action of the powder; this hole is charged with a certain portion of gunpowder, and is then filled by clay, or more usually with a soft kind of rock, which is rammed into it, leaving a small orifice through which the rush or fuze is afterwards introduced for setting fire to it. The most dangerous part of this process is the ramming in of this soft rock to confine the powder, which is technically called tamping; this used to be done with an iron bar; that bar striking siliceous portions of the rock, inflamed the

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powder, and the men were injured, perhaps killed. The first improvement was making that bar of copper, or a part of it of copper; still the needle or small rod which is introduced in the tamping, to preserve the orifice for blasting, was of iron, and that sometimes inflamed the gunpowder: some years ago we substituted copper instead of iron, and in doing so had very great difficulty with the men; it was one of the strangest things possible to see the masters and the agents taking all possible pains to preserve the men's lives, and to find the men so reckless, that though those copper needles were given to them at the same cost only as the iron ones, they would not for a long time use them. I believe we prevailed at last by depriving all the men who were injured in that way of the relief which is usually given from a fund raised in the mine; and I believe that was more effectual than anything else that was attempted, though we tried fines and many other expedients. That copper needle is now generally used, which is the second improvement that has been introduced; but I think the last improvement is one of the best; it is the invention of a person in Cornwall, who has made what he calls safety fuzes, instead of the usual practice of filling a rush or tube with powder and dropping it into the hole; this person has invented a cord, in which is introduced a thin vein of gunpowder, and is covered with tar or pitch; and the safety this gives is owing to a certain length burning in a certain time. Accidents took place frequently to the man who had to fire the hole; for instance, in sinking at the bottom of the shaft, the workman has to fire the hole and then to be drawn up by a single rope over it; if the fuze communicate to the gunpowder more rapidly than he expects, he is blown to pieces; but with the safety fuze he may take two feet or three feet, and so delay the explosion that he may be sure to be in a place of safety before it happens. This is made so cheaply, that no difficulty has been found in its introduction; the men are supplied with it, so that it is not worth their while to make the common fuzes, and I think it is one of the most happy thoughts that has occurred.

166. Is that in general use in the mines in Cornwall?—It is used in many of the mines.

167. Is it your opinion, or not, that its adoption is universal?—I believe it is general in many of the principal mines in Cornwall; I have sent specimens to all the other mining districts with which I am connected in different parts of England, but I think it has not yet met with the attention it deserved.

168. But it is your opinion that it is the bounden duty of all miners and agents to see that that is introduced into general use?—I think so.

169. Why were the men averse to the use of the copper needle?—The instrument is subject to be broken, and the men could easily get iron ones repaired; and it was objected that it would be difficult in copper ones. We answered this by exchanging new ones for the broken parts.

170. Have they not some composition rammers made for the tamping?—Yes.

171. Was there not a prejudice among the miners against them?—There was; I do not think they are much used now; the needle is the most important.

172. You have alluded to three specific improvements, the tamping bar, the needle, and the safety fuze; have you formed any opinion as to the relative decrease of accidents in consequence of the introduction of those improvements?—I cannot say that I can state that statistically, or exactly; my impression is, that accidents are less common than they used to be.

173. Would you suppose that there is not one now, where there were two formerly?—I believe that may be the case; the Committee might perhaps get at the statistical fact of the number of lives lost in Cornwall by the returns from the coroners.

174. Are you all liable to sudden and calamitous accident from unexpected inundations of the mines?—I should say not; I do not recollect a case.

175. No cases of that nature have come under your immediate notice?—No; I do not recollect any loss of life from a cause of that kind; the only case of apprehension is where an old mine is attacked, and where levels are driving towards collections of water; but though I have had to direct several such, I do not recollect any instance of a fatal accident.

176. Do you find yourselves placed under very disadvantageous circumstances for want of correct plans of former workings?—Not now; that was the case 30 years ago.

177. You are of opinion that it is the invariable practice of the miners to map out

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out their mines correctly?—It is very much our practice at present, but it did not use to be so.

178. Do you consider it exceedingly essential for the interest of posterity, as regards collections of water, or as regards coal mines, magazines of carburetted hydrogen, that those maps should be correctly made and carefully preserved?—Most undoubtedly I do; perhaps I may explain that I consider it more important to the public in collieries than in our mines; collieries being worked upon a horizontal plane, differ very much from our mines, which are worked upon a vertical plane; the beds of coal lie flat in a colliery, but mineral veins are either vertical or nearly so. Now it concerns future times very much indeed to know how far horizontal workings may be extended; and if the map is lost, great danger may ensue to a colliery; but ours, being vertical, do not interfere with one another so much; there is not the same probability of breaking into old workings as in the other case; but in both cases correct sections and maps are, I think, most important things; and I believe the value of them is now very much appreciated, though it was not formerly.

179. Are you speaking of copper mines?—Copper and tin in Cornwall.

180. But none of those mines lie with the same regularity as coal mines do?—The veins are nearly as regular, but very irregularly enriched.

181. As it is the habit and practice of miners to take those portions, or lodes or seams which are nearest the surface, provided they are of a regular value, the necessity of those plans is, in your opinion, greater and greater as time flows on, in consequence of future workings necessarily being at the depth of the present workings?—Certainly.

182. And therefore the pressure of water or gas will be an accumulating pressure as regards future workings?—Certainly it will, the column will be higher. I may mention, perhaps, that this is so well felt by the owners of mines, that it is almost a constant covenant in Cornwall now, that the adventurer shall prepare plans and sections: the want of plans will not be felt again in Cornwall as it has been, because in the last few years most of our deep mines have been opened and re-worked.

183. Is there not a plan kept now generally in every one?—Yes, there is a draftsman generally employed in large concerns.

184. And the map enlarged as the mine is carried on?—It is carried on every month with us; in fact, it is a regular progress.

185. Will you give to the Committee a general view of the lodes or mines in Cornwall?—The ores of the soft metals, copper, tin and lead, are found in veins having very much the same character; in Cornwall and other parts of the world they may be considered as vertical fissures, or cracks in the rock, to an unknown depth and unknown lengths, but of determinate widths, the widths very often varying considerably.

186. Do they generally proceed in straight lines?—Nearly in straight lines, unless interrupted by cross veins.

187. From east to west?—The direction of the veins in Cornwall is varying a little from east to west, but in common parlance they are called from east to west; there are numerous veins that cross them, but in Cornwall these veins are totally unproductive; the veins in limestone in Yorkshire and Cumberland, containing lead, have a variety of direction, some completely crossing the others; some are not exactly parallel, and therefore intersect in various directions, which adds to the intricacy of their working, but this also adds to the power of ventilating.

188. What is the width of the vein?—It varies from an inch to 12 or 14 feet, the latter dimension is very rare; I should say generally, in Cornwall, from two to four feet; the greater part of the vein is entirely unproductive, even in the richest mines; the ores are found in masses, arranged according to no rule, and therefore the business is so uncertain and speculative.

189. You have spoken, in a former part of your evidence, of the accidents occasionally arising from the ascending and descending of the miners; will you explain to the Committee by what mechanical power the miners are lowered to their work, or are raised again to the surface?—This is a subject that is now occupying our attention a good deal, and perhaps we were more interested by it on account of the diminution of animal force, or the real waste of labour, than from other considerations; I do not think there is any want of humanity in the owners of mines, but the accidents are but few; the mode of the men's coming up and going down is almost universally by ladders.

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190. Do they extend 500 yards by ladders?—Yes, 520 or 530 yards; the ladders are generally placed on some of those internal shafts called winzes, so as to form stages; the descent is not all in one line; there are resting places, but still it is a work of great labour, even to the men most used to it, and it has been estimated that it diminishes the power of the men at least one-fourth. I mean those men that work at the bottom of deep mines, say 200 fathoms deep, where the man is obliged to reserve nearly a fourth of his strength to go up and down.

191. What is the time consumed in going up and down?—About 20 minutes each way; they go down quicker than they come up.

192. Is there much difference in the time in going down or coming up?—I think there is, because the men go down fresh from their home; besides, the man has his weight in one case to raise to the surface; there is not so much labour in going down.

193. Are those shafts perpendicular?—Mostly, but we do not send the men down a perpendicular shaft to that depth; we take many different places, that he may go perhaps 20 fathoms in one depth, then a little way horizontally, and then another 20 fathoms downward, so as to divide it into stages.

194. Would there be any objection to one or more of the shafts being perpendicular?—Our great shafts are perpendicular, but not always so.

195. Then there are stoppages, so as to break the extent of the descent?—Yes.

196. And those stoppages enabled the miner to place the ladders a little out of the perpendicular?—Yes; the veins being somewhat inclined, it is common to make the foot-road upon the workings of the vein, and that allows the ladder to be placed a little inclined.

197. What is the average distance of the ascent that he goes from the surface?—Perhaps one might take 100 fathoms as about the general average of the greater number of men working. The mines in Cornwall vary from 40 fathoms in depth to 250, but much the greater number of men work at a depth of 100 fathoms.

198. Why should they not be raised and lowered by machinery?—On account of the danger. I should explain that the shafts in which machinery can be employed are not always perpendicular to the bottom of the mine; they are intended to be perpendicular to a certain point when first sunk, say 100 fathoms deep; here they meet the lode, which having an inclination, it being still desirable to continue the shaft, it is then carried upon the inclination of the lode, and becomes an inclined shaft; and I can hardly conceive any way of sending men down such a shaft by machinery that would be safe; in fact many of the accidents that do happen to men going up and down is from their taking advantage of the bucket and rope, contrary to orders. Very few accidents happen from the ladders.

199. What is the distance between one stage and the other in going down?—The ladders are seldom made above 50 or 60 feet in length, from one stage to the other.

200. Are they so long as that?—I think they are shorter; it depends much upon the position in which they are placed.

201. What is the perpendicular step for the men?—Nearly a foot.

202. You have stated, that an improvement in the mode of ascending and descending the mines is at the present moment a subject of anxious inquiry on the part of the miners in Cornwall?—It is.

203. Has anything been suggested to such an effect as to render it probable that such improvements will be introduced?—Mr. Robert Fox has proposed a premium, which he offered himself through the Polytechnic Society in Cornwall, for plans of such an invention; and I understood, though I have not seen them, that several ingenious devices were brought forward, but none were thought quite practicable. The premium is still offered by him, and I know that it is the intention of some of the principal miners of adding so much to that premium as to make it worth the while of ingenious men to turn their thoughts seriously to it; it has been proposed to adventurers in the Consolidated Mines to offer 50 guineas.

204. Will you be so good as to state to the Committee what the amount of the prize offered by Mr. Fox was?—I believe it was 10 guineas.

205. You have spoken of a Polytechnic Society in Cornwall; how long has that society been in existence?—I believe about two years.

206. What are the objects of its institution?—To encourage native talent, which

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which seems to exist there, for mechanical invention, and the name has been taken from the circumstance of their encouraging also works of art, drawings, &c.

207. Would you draw any distinction between a polytechnic society having those objects, and what are called mechanic institutions?—This society is not provided with the means of instruction which the mechanic institutions are; it has no library; it rather holds out a reward for invention, or works of art.

208. The specific object of this institution the Committee understands to have been the general advancement of mining science, in a mining district?—That is its principal object.

209. How far has the society been encouraged in its proceedings by the results that have attended the labours of that society?—Sir Charles Lemon is the president, and one of my sons is the present secretary; I understand from both that it had been taken up by the persons whom it was desired to benefit, and that a great deal of zeal was shown by those classes, and that there was a prospect of a great deal of good being done; already it has produced one or two little inventions; one connected with steam-boilers, and very much calculated to attain the object which has been stated, as to the importance of ascertaining the quantity of water in a steam-boiler; I think it is an invention by a man working at the Perran foundry.

210. Are you able to state that the parties interested in the mining district in Cornwall are encouraged to expect beneficial results from that society?—I have no doubt of it.

211. What constitutes the right to membership?—I think 10*s.* a year subscription.

212. Is it understood to be placed upon such terms that every practical man can have access to it?—Quite, I believe.

213. Are the meetings periodical?—Yes, but not very frequent; I believe once or twice a year.

214. Is there any council, or other body, who dictate as to the nature of the business to be brought before those meetings, or the form in which it shall be introduced?—There is a committee who superintend that.

215. And there every precaution of science, for the benefit of the owners or of the workmen, may be introduced and discussed?—Certainly, and rewarded.

216. Are premiums given for beneficial and useful inventions?—That is the principal object of the society.

217. Are their proceedings published?—They have lately published a report.

218. Is it your opinion that the establishment of such societies in the mining districts, calculated to comprise those parties whose personal and pecuniary interests are at stake, would be highly advantageous?—Certainly; this has always been a very favourite object of mine.

219. Are you aware that the Natural History Society, at Newcastle, have bestowed great attention upon a general mineral map of the counties of Northumberland and Durham?—I was not aware of that: I was one of the deputation lately to the Chancellor of the Exchequer, urging the publication of the Ordnance Map, which would be the best basis for such an undertaking. We have the advantage of that in Cornwall and Devon; and lately, under the Ordnance, a most beautiful specimen of what may be done as to mining has been exhibited in part of the map of Devonshire, by Mr. De la Beche.

220. Is that published?—Yes.

221. Where may it be had?—At Gardiner's, in Regent-street; every lode or mineral vein in that district is most correctly shown.

222. Can you give the Committee any idea of the present situation of the mining population of Cornwall, as connected with education, religious instruction and moral habits, taking a review of the last 20 or 30 years?—I think their moral habits are generally improved: I have known them 36 years; they are less inclined, I think, to drunkenness; perhaps there is more small drinking in the beer-shops, but I think there is not the same quantity of drunkenness that there was 30 years ago. In their religious education a great deal has been done; Methodism prevails a great deal in Cornwall, and I think it has had its good effect; there is not now the fighting which was formerly prevalent.

223. Has the general diffusion of knowledge seemed to produce that developement of native or inert talent which might be reasonably expected from such diffusion?—There never appeared to be so much deficiency of education in Cornwall as in most other counties; I never knew the time when many of our common

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people could not read and write, and in fact their business rather requires it; and though I am not very clear how they acquired the knowledge, considering how young they go to work, yet I have always observed that the quantity of knowledge of that kind that they possessed was remarkable; many of them are tolerable mathematicians in the lower departments of that science, and there is a tendency certainly to learn and acquire information of that kind.

224. Are they much in Cornwall exposed, particularly to working in the great extremes of wet and dry?—They work very much in wet places.

225. Is the position of the body very painful in many of those mines?—I think not; they work in every possible position, but owing to that circumstance, they are remarkably upright and well made; I have always attributed it to the varied position which their work requires.

226. It is the fact, that in the West Riding of Yorkshire, and in other parts of the kingdom, the men have to work upon their sides; is that the case at Cornwall?—Often, but not continuously. With respect to working in wet places in Cornwall, the habit which has always obtained of the men changing their clothes when they rise to the surface, is very beneficial.

227. Is it the practice of the men to provide themselves with clothes to change, on returning from their work?—Men provide themselves with their own clothes, but it is the practice of the owners in the best mines to provide conveniences, in which the men's dry clothes may be kept, and the wet clothes may be dried before they want them again. In the Consolidated Mines there is an excellent establishment of that kind, heated by long tubes, where the clothes are hung up to dry, and where they are attended by some old men, who take care of them.

228. Is it within the range of your experience, that such an arrangement has been attended with beneficial effects on the general health of the men so employed?—It is quite; and in the West Riding of Yorkshire a contrary practice obtains, and I have taken very great pains, particularly in the Duke of Devonshire's mines there, to introduce the plan of the men putting on dry clothes after their work, and hitherto without effect.

229. You are alluding to the mines in the neighbourhood of Sheffield?—In the neighbourhood of Shipton; and the miners are there particularly subject to consumptive complaints, and I believe are much shorter-lived than in many other mines.

230. And you attribute that, in no small degree, to the miners not changing their clothes when they come to the surface?—Very much.

231. Do the miners live in the villages near the mines?—They are in Cornwal much scattered over the country; the habit of granting life-leases of cottages is very prevalent on the wild downs near the mines, and they are situated all over the mining country.

232. So that, in the average, they may have a greater distance to go from their residence to the place of work, than a pitman in the north of England?—Yes; a great many travel from four to six miles.

233. But they change their clothes the moment they come up to the surface?—Yes, always; the Cornish miner would consider himself degraded to appear in his dirty clothes.

234. And there is a room for changing his clothes in?—Yes.

235. Has he an opportunity of washing and cleaning himself as well?—Yes, and has the advantage of warm condensing water to do it.

236. Sixteen hours would elapse before that man went down again?—Yes. In reference to the bursting of steam-boilers, I do not think that in Cornwall much loss of life has been occasioned by that cause; it is true that we have every now and then a boiler bursting in Cornwall, but I think a very small number of men have been killed by it.

237. Can you give the Committee an idea of the extent of power employed in the mining districts in Cornwall?—I took some pains to ascertain that, and found it was a power equal to 44,000, but I omitted in that calculation some engines of which I had not an account before me.

238. Will you describe the majority of those engines as condensing or non-condensing engines?—They are all condensing, working steam of high pressure, but condensing.

239. What do you consider high pressure in Cornwall?—25 lbs. to 40 lbs.; 25 lbs. an inch I think is the usual pressure.

240. Has your attention been called to hydraulic machines, for the purpose of raising

raising and lowering the men to their work?—My own attention has not been very much given to any particular mode of doing it.

241. If you were about to employ either ropes or chains, which, as a scientific gentleman, would you prefer for raising and lowering the men?—Rope is the most certain; a chain, however well made, will have certain links which are imperfect, and on that account they are uncertain, and often break when least expected.

242. Without any preparation or notice?—Yes.

243. On the other hand, a rope will be more safe, because it will give you notice?—Yes, it may be examined.

244. Are you aware of a plan existing in any part of the country, of lowering the men in vessels of different descriptions, guided by grooves, from one part of the mine to the other?—I am not aware of that in England; I know that in Germany such plans exist.

245. Do you think that liable to great objections?—I am afraid that for us it would not send down a sufficient number of men in a given time; we have about 1,400 men working under ground in the Consolidated Mines, and of course a third of that number to be raised and lowered every eight hours.

246. Then the men ascending and descending will present the stream of a continued line?—From having a number of shafts and ladder-roads, that is not so apparent.

247. Then any man losing his foot-hold, or being suddenly seized with illness, would not be liable to strike off the others?—Yes, he would.

248. Have such cases occurred?—I think they have, but not very often.

249. You are acquainted with the Durham district?—The borders of Cumberland I know very well; the Durham mines I do not know so well.

250. You know the lead mines?—Yes.

251. What is your comparative view with respect to the system pursued there, as to the ascent and the descent of the men?—The ascent is there altogether different; the mines are very shallow, and are almost entirely worked from levels driven from the valley into the hill, so that the men go in and out of those mines upon railroads, drawn by horses; I am speaking of Alston Moor; and I believe in Mr. Beaumont's mines there are very few that go very deep under the dry-level.

252. Those are the Stanhope mines?—Yes.

253. What would be your opinion of the care taken in the ventilation of those mines compared with the ventilation of the mines in the West of England?—The ventilation is very good; they have numerous means of communication, and though their shafts are not numerous they generally have sufficient openings to the surface to produce the current that is necessary.

254. Those are perpendicular communications with the open air, by means of what are called staples?—Yes, they are.

255. Do you agree in the view taken by Mr. Gurney, whose evidence you have heard, of the dangerous consequences of gunpowder in fire-damp?—Yes; I agree with him as far as my experience of fire-damp goes; that is not very great; but gunpowder is hardly used in mines exactly in the way in which he stated to be so dangerous; where fire-damp exists the danger would be in lighting the fuze, because in all the common practice the miners would apply flame to set fire to the fuze; in that case Mr. Gurney's application of percussion, in some way, would be an excellent thing, but I do not believe any danger would take place, for the reason he gave, from the explosion of the gunpowder itself. I agree with Mr. Gurney as to the inefficacy of the Davy lamp, not for the scientific reasons which he gave, but from my practical knowledge of the carelessness and indifference with which the men will rush into danger.

256. Do you attribute the failure of the Davy-lamp to the carelessness or ignorance of the miners?—In Sir Humphrey Davy's lifetime, and when the thing was first started, I always doubted its value, because I considered that it was likely to lead men into situations of great danger, which they would not be exposed to otherwise, and because I feared that it would tend to make the owners of collieries not take the same pains for ventilation that they otherwise would do, my opinion being, that the only safe thing for collieries is to get rid of the gas if possible.

257. Have you found your calculations correct, for the most part?—I am afraid that my experience is so; I am not sufficiently acquainted with the facts to state it positively; but the opinions of others I have heard, confirm that; and the comparison of the cases of loss of life appear to me to be quite as numerous since the introduction of the lamp as before.

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258. Do you attribute that chiefly to the carelessness of the miners, or to their ignorance, from the lamp not being of a sufficiently simple construction?—I fear there is no way of knowing how these accidents take place; but either carelessness or the theoretic reason that Mr. Gurney has given, may produce the evil; a hundred men's lives are at stake owing to the carelessness or indifference, or improper conduct of one.

259. Is it not the case that the mesh of the wire-gauze is so close as to admit of a very imperfect light?—I have not been much under ground since the Davy lamp was introduced, so that I have not much experience of it.

260. It has been suggested that the men find it irksome to work by so obscure a light, and that therefore they unscrew the top of the lamp to have a fuller light, and that then, unexpectedly, an explosion takes place?—My opinion was grounded upon the general experience I have had of the carelessness of the workmen, their indifference to danger in handling gunpowder; I have seen such things done, and my life has been put in peril by such careless acts as one cannot suppose; and thus it appeared to me, that putting a refined instrument into such men's hands would not avoid the danger: a careful man may go through a magazine of gunpowder with a lanthorn, but it is not a position that it is desirable to be placed in.

261. But your experience satisfies you that many foul mines may be worked, through the agency of that lamp, which could not have otherwise been worked?—Yes; and that a great deal more coal may be raised by the lamp, I have no doubt.

262. But the risk may be, notwithstanding, considerably greater to the miners than previously?—Yes.

263. Do you conceive that a greater number of accidents have occurred since the introduction of that lamp?—Yes, from what I have heard, I think so.

264. That you would attribute to the increased risk which has been incurred under the apprehended protection which is obtained by the use of that lamp?—Decidedly.

265. Have you had any personal opportunity of observing the effect upon the health of any given number of men, working in a noxious atmosphere by the aid of that lamp?—No, I have not.

266. Are you much annoyed in Cornwall by the prevalence of choak damp or black damp?—No; the only vitiation of the air we know is that occasioned by the men's breathing and the burning of the candles, occasioning the simple abstraction of oxygen from the common air; we have no other gas, though of course much the same thing as the choak damp is thus produced; but it comes gradually, and therefore may be always met and guarded against.

267. Having had an opportunity of hearing Mr. Gurney's evidence on the illumination of mines, does it strike you that that is practicable as regards the Cornish mines?—The subject is so new a one that I can hardly give an opinion; but if the fact of reflection can be managed as easily as Mr. Gurney says, though it would be more difficult in a Cornish mine than it would in a colliery, yet I think it might be applicable to some extent.

268. In speaking of the Cornish men, are you not limited to the number of men you employ, on account of the want of air?—That would be in certain places, where the men were driving a particular level; till a communication is made the air may be bad, and you must limit the number of workmen.

269. Have any facts, connected with the Yorkshire mines, in the neighbourhood of Shipton, and the lead mining district in that part of the country, come under your knowledge, varying materially from what has been already described as concomitant to those of Cumberland, Durham and Cornwall?—No. The mines in Yorkshire are also worked like the mines in Cumberland by a level, but they are not accessible in the same way; the level is very long, and the miners go up and down in the Cornwall manner; in fact, in those mines we have Cornish agents, and the means for going up and down are the same, and also in North Wales.

270. And there is equal care bestowed upon the circulation?—Yes.

271. And the men you would consider equally healthy?—I have stated in Yorkshire that I do not consider the men so healthy or so long-lived; I think it is owing to their not taking care of themselves in changing their clothes when they come to the surface, walking over a very exposed and high country for three or four miles in the clothes they work in.

272. Is it not a fact that the miners in Durham and Cumberland are very short-lived, compared with the surrounding population?—I have understood that is so.

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There may be one cause for that; in Yorkshire the mines there often work in grit-stone, and being exposed to the dust of the grit, pulmonary complaints are induced.

273. Then you take into account the exposure to wet and dry, and also to this atmosphere, loaded with the siliceous particles?—Yes; and I have understood in Yorkshire, since we have worked the Duke of Devonshire's mines deeper, and into wet ground, the men's health is observed to improve.

274. Does the same remark apply to the North Wales mines?—The men are more healthy; they change their clothes there now. I have not known Wales for more than 12 or 14 years, and the regulations are very much those of the Cornish miners, for there are many Cornish agents there, and the Cornish habits are introduced, to the benefit of the workmen.

275. Your observations, with regard to the Cornish mines, have been principally applicable to copper mines; do they not equally apply to tin?—They do; the tin mines are perhaps the most healthy of all; they are not generally so deep in Cornwall as others.

276. Then the result of your own experience, as a practical man, would not be a very unfavourable comparison between the casualties attending the Cornish miner's life, and those of the surrounding population?—Certainly not.

277. And you would draw a wide distinction between the casualties of a large coal mine in the North and those of a large tin or copper mine in Cornwall?—A very wide distinction indeed.

278. That is, there are more casualties in the coal mines than in the Cornish mines?—Yes.

279. Is the ventilation of the mines you are acquainted with generally imperfect?—In the collieries, I have stated that I have not so much practical information; but I know that the greatest pains are taken to produce ventilation in the collieries, but there you have the production of a peculiar gas.

280. Do you not think that improved ventilation would be a means of preventing accident by damps?—Without presuming to know so much of collieries as to dictate to those that manage them, I have always thought it desirable to try a more perfect ventilation of collieries, either by introducing a system of more numerous shafts, or by some mechanical power.

281. You are aware that the great obstacle to multiplying the number of shafts in sinking through a difficult strata, is the expense; are you aware of the expense frequently incurred in the counties of Durham and Cumberland in sinking a single shaft?—I am not aware of the exact cost.

282. Are you aware that it would exceed 100,000*l.*?—That seems an enormous sum, certainly; I suppose a shaft, merely for ventilation, would not cost nearly that money.

James John Wilkinson, Esq., 1, Pump-court, Temple, called in; and Examined.

James J. Wilkinson, Esq.

283. HAVE you for some years taken a lively interest in the working of coal mines, in the northern parts of this kingdom?—Yes; in the calamitous accidents which have arisen in the working of coal mines.

284. Are you one of the original members, if not the original proposer, of a society for preventing accidents in coal mines, in the county of Durham?—I was the original proposer of that society.

285. Can you give the Committee any information relative to the objects of their inquiry?—On the 25th of May 1812, an accident happened at Felling, near Gateshead, in which 92 persons suffered. I was particularly struck with this very afflicting accident, and the more so, from a circumstance which I am sure will have its due effect upon the Committee, and that was this, that after 90, if not the whole of the sufferers had been taken out of the mine, and on a particular day, the coffin of what may be called the first of the sufferers began the procession, which increased before it got to the church until it amounted to a procession of 90 coffins, with mourners; this struck me particularly, and I thought if this could possibly be remedied, it would be doing a great good to society. I went into the north of England in the long vacation of 1813, and I consulted many of my friends, and the result was that I considered it my duty to call the attention of the public to these accidents, to have a full investigation into the whole subject, and to see if any remedy could be applied. On the 1st of September 1813, I published, and sent into Durham and Northumberland, proposals for a society for preventing accidents

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in coal mines; this was circulated by letters, &c., very extensively, and among the rest came to the notice of the late Bishop of Durham; his lordship wrote to the late Dr. Gray, afterwards Bishop of Bristol, to say that he gave Dr. Gray a *carte blanche* to do anything that might be necessary in the formation of such a society. After consulting with many of my friends, with Sir Ralph Millbanke, and Dr. Gray, and Dr. Clanny, on the 27th of September 1813, was published a handbill for a public meeting for the establishment of the society at Sunderland, and on the 1st of October 1813 the meeting was actually held at Sunderland, Sir Ralph Millbanke in the chair, in which a committee was appointed, and I had the honour of receiving the thanks of the society for having suggested the plan of the society. The committee began its meetings, and received a variety of communications, and one, which I beg to call the attention of the Committee to, was a communication from Mr. William Chapman, now deceased, the celebrated civil engineer, on the causes of frequent explosions of inflammable gas. In November 1813, the society published its first report, which I beg to lay upon the table. (*The Witness delivered in the report, which was laid upon the table.*) That report contained a preface, stating that their funds were small, and that they had received several communications, and among the rest a very valuable letter from Mr. Buddle, which forms the basis of their first report. It was soon ascertained that the townships and parishes were extremely negligent in calling upon the coroners in cases of accidents, and Dr. Gray spoke to the magistrates, and the consequence was a charge at the sessions, which brought on a better system; and by Sir John Bayley also, a charge at the assizes, which contributed to the like effect. It was thought advisable to apply to Sir Humphrey Davy, and I called at the Royal Institution on Sir Humphrey Davy, but he had gone to Paris; I put a letter into the post-office for him, but not having paid the foreign postage, it was returned to Mr. Burn, the secretary of the society. In 1815, Dr. Gray was requested to write to Sir Humphrey Davy, as chairman of the committee, to interest himself in the cause, and Sir Humphrey Davy came into the North either in August or September 1815, and met several of the gentlemen of the committee, and others, at Dr. Gray's. Sir Humphrey Davy afterwards saw Dr. Clanny and his lamps, and I am persuaded derived considerable advantage from them. Sir Humphrey Davy's lamp came out in 1816. I am sorry to state that the society received very little support or funds from the coal-owners, but I am glad to state that there was a greater vigilance in working coal mines, and a better system; that fewer accidents happened; and I am persuaded many valuable lives preserved to their families and their country. Mr. Buddle's pamphlet was a valuable addition, both to the miners and to science. Sir Humphrey Davy's and Mr. Stephenson's lamps also contributed to reduce those accidents. I believe much remains now still to be done. The accidents in coal mines may arise from improper working, as to which I beg to refer the Committee to Mr. Buddle's letter, in our first report. During the time that the society was in activity, a person of the name of Ryan, from Ireland, came to the society with a new system of ventilation, the object of which was to do away almost entirely with the braticing and boarding of what may be called the old system, but Mr. Ryan's plan did not succeed. Another system of working will be explained to the Committee by Mr. Martin. Accidents may also arise from improper ventilation. I beg to refer the Committee to the plans of ventilation mentioned by Mr. Buddle, in our first report, by a furnace, page 6; by a water-wheel, page 6; by a hot cylinder, page 7; by air pumps, page 7; and by air-coursing, page 17; and also to the defects of the system, in page 21. After the ventilation comes the system of light to the miner; and I beg to refer the Committee to light by candles, mentioned by Mr. Buddle in our report, page 18; by the steel mill, in page 20; then come the different lamps. The first lamps in priority are Dr. Clanny's, who has been the inventor of several, and has been an indefatigable labourer, but I am sorry to say has received no reward. Sir Humphrey Davy's is a beautiful invention, and a great improvement, and did great good; but on inquiry in the North of England, I believe it is liable to accidents by pieces of coal, by the stour, particles of coal-dust, settling on the meshes, and by sudden blowers of gas; and I think it would be improved if there were a rim which would keep what we call the stour in the North, the dusty atmosphere, from descending upon the gauze; and if the upper part of the gauze was made in the shape of an inverted cone, the dust would be less liable to settle. Sir Humphrey Davy's lamp, in my opinion, has suffered from the indiscreet

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discreet zeal of his friends in not allowing it to be an imperfect instrument, or rather in insisting that it is completely perfect. It was soon ascertained, I believe, that Sir Humphrey Davy's lamp wanted a sufficient light, and a reflector was added to it; whether it is now used or not in collieries, I am not aware. With Sir Humphrey Davy's lamp ought to be mentioned Mr. Stephenson's, another valuable addition to coal mines, on a similar principle; there is a dispute as to priority between Sir Humphrey Davy and Mr. Stephenson. I now come to another subject of considerable importance in working mines, which has already been mentioned to the Committee, and that is the danger that arises from breaking into old workings or wastes. This occasioned the dreadful accident at Heaton, and for preventing this in future, I beg to present to the Committee two pamphlets by Mr. Thomas and Mr. William Chapman, on the propriety of having maps of all the workings of coal mines. I beg leave also to call the attention of the Committee to the lead mines, and to express my opinion that cleanliness must add considerably to the health of that body of miners, who suffer much in their health.

286. Have you any further evidence to give to the Committee?—I have no further evidence at present, but I shall be happy to hold myself at the pleasure of the Committee, should they wish me to attend, or should I find anything that I may think worthy of their notice.

Jovis, 18° *die Junii* 1835.

JOSEPH PEASE, ESQUIRE, IN THE CHAIR.

John Martin, Esq., called in; and Examined.

John Martin, Esq.

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287. YOU are the gentleman known to the world as an artist?—Yes, I am.

288. The Committee understands that you are desirous of stating to it your views upon the nature and causes of those calamitous accidents which have occurred in the coal mines in the north of England, with a view of suggesting some plan by which those accidents may be obviated, or in a great measure prevented?—Yes, I have a plan for that purpose, to show how it may be effected in a much more perfect mode than that at present adopted.

289. The Committee understands that the plans relate to a superior method of ventilating mines?—Yes, [*the Witness produced the Plans.*] I think the best mode for my purpose will be, first to show the imperfect mode at present adopted, and where I conceive the evils exist. This is a plan enlarged upon that which Mr. Buddle has given in a pamphlet describing the great explosion which took place at the Jarrow Colliery on the 3d of August 1830, and which has been published at Newcastle.

290. You understand this plan to be a fair specimen of the system upon which the mines are generally wrought?—It is given by Mr. Buddle himself; he is the viewer of the colliery, and is considered the greatest viewer in Northumberland.

291. You observe two drifts set away from the shaft, for the express purpose of providing for the ventilation of the mine?—Not solely for that purpose.

292. Will you state to the Committee what, in your opinion, constitutes the imperfections of the system at present pursued?—The defect of this plan is owing to the immense number of angular recesses, which the workmen are perpetually coming in contact with, and the moment of contact is a point of danger.

293. What do you mean by "angular recesses"?—The branch workings at right angles with each other, being closed at one end, they are filled with a great quantity of foul stagnant air, so that when they come into contact with, and are opened into each other, the air takes a new current, drives the foul gas out of the recess, spreads it about and makes it combustible; and this is where danger lies, the explosions having generally taken place at such points. There is another dangerous point in this mode of working, namely, where the trap-doors are; many explosions from that cause having taken place in my recollection. When I was in the north country I remember several explosions occurring from boys being set to watch the trap-doors, who had not attended to their duty; the doors had not been closed quickly enough, the stagnant air, which was pent up by means of the trap-doors, had been put into motion, and become explosive; if it happened, however,

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however, to be too strong for the candle or the lamp, it would not go off; then the candle would be as safe as Sir Humphrey Davy's lamp.

294. Has any other danger occurred to you as connected with the mode of working the mines, as described by Mr. Buddle?—I do not think I can point out any other at present; those are the main defects, and very great ones, which might be overcome by another principle.

295. Have you prepared any written statement which shall at once place the Committee in possession of your own views?—I have.

[*The Witness produced the same, which was read as follows*:]

"I recommend, in the first place, that after the direction of the coal has been determined, a shaft should be sunk at the lower part of the intended mine, from which shaft a gallery or headway should be cut in a straight line to the whole length of the lower side of the works; this headway, after turning off at a right angle to the entire width, should turn again at a right angle to the whole length of the works, thus forming a gallery round three sides of a quadrangle where the line terminates, the up-shaft (to draw off the gas by means of a fire, air-pump, or fan) should be constructed. In the event, however, of the expense of the two shafts being considered unnecessarily great, one might be sufficient; in this case the shaft should be braticed or boarded off, so as to answer the purposes of two, the gallery commencing at the side that would serve as the down-shaft, and terminating at the side serving as the up-shaft. For the purpose of drawing off the foul air, during the formation of the gallery, a small tube (connected with the fire or air-pump) should be used; but the tube will be no longer necessary, and may be entirely removed when the ventilation gallery is completed; for then the air will rush down the down-shaft, sweep round the whole works and out at the up-shaft, effecting the most perfect circulation from one end of the line to the other. To maintain the same system from the beginning to the end of the works, it is essential to commence at the farthest side of the quadrangle, and to work the coal in a straight line from side to side, the air would then sweep across where the men are working, and so get gradually nearer to the shafts, till the entire mine is worked. By these means, I think the whole of the coal may be taken away without fear, excepting where troubles are met with, and then pillars should be left to support the roof. The advantages of this plan over any at present in use, are, first, all the corners from whence, by the present system, the gas cannot be cleared, and which are consequently always liable to, and do frequently explode, will, by the above plan, be entirely removed; and a perfect system of ventilation being thus obtained without change of principle, from the commencement to the termination of the works, by the stream of fresh air sweeping round the mine, and carrying with it all the foul gases, not only would the air be rendered wholesome to the miners, but the possibility of explosions would be obviated, even though the men used naked candles, so often stated to be the cause of explosions. Secondly, a greater quantity of coal can be obtained, since, even if the roof was to fall in, it would be so far back in the spent works as not to interfere in the least with the ventilation, and I cannot but repeat, that I think the entire body of coal might be removed where there is no fear of water from above. Thirdly, the labour and expense of building and braticing or boarding, used in the other system for the purpose of ventilating, are entirely dispensed with.

"I have endeavoured to convey a slight outline of my plan, but I cannot give any adequate idea of the details without the aid of diagrams; these, however, are all prepared and ready for inspection."

296. Have you any objection to put the Committee in possession of that plan?—It is for that purpose that I have come here.

297. Have you any objection to leave the models of your improved method of drawing off the foul air, in the possession of the Committee?—I shall be very happy to do so.

298. Are you aware of the time ordinarily consumed in sinking a shaft in the coal district on the banks of the Tyne?—I understand they are very expensive works, and on that account I recommend that one shaft shall be divided into two; but in all great mines in the north, I understand that they have two shafts or more, because, according to the extent of the work, it would be to their advantage to have another shaft nearer, rather than to carry the coals so far. One advantage of mine over the other plan is, that the greatest extent of this mine is no more than four miles, and it gets less and less as coal is removed; whereas, by the present

present principle, they will have as much as 80 or 100 miles to go in those various turnings; and every one of the places must be stopped to compel the air to go in a certain direction, and even then they are not all ventilated.

299. Are you aware that from one to two years are frequently consumed in sinking a coal-shaft?—I was not aware of that; it is a long time since I have been in the north, and I have not any recollection of the workings of the mines since that time; but we must have the same shaft for any plan: it will make no difference as to the depth, or width, or cost of the shaft, for one plan will require as good a shaft as the other.

300. Have you formed any idea of what the width or the dimensions of the drift ought to be?—It must be wide enough for a horse and waggon to bring the coal from the extremity of the mine; but as we have in my plan a straight line, and that a short one, it would be more simple on that account, and the men would have a less distance to bring the coal.

301. Have you formed any specific idea of the required dimensions of such original drift?—I have not considered that at all: I suppose the miners will know what would be a proper width; but we could afford to give them a better railway on which to bring the coal, and even a greater space.

302. Supposing the width of that drift to be three yards or nine feet, how many men do you suppose could work at that drift at one and the same time?—That I cannot answer; I do not know how close the men work to each other.

303. Are you at all aware, supposing the work to be continued, that is, three shifts of eight hours each, how many yards of such shaft would be accomplished in the space of 24 hours?—I have not calculated that at all.

304. Supposing that by such means three yards progressively could be accomplished in the course of 24 hours, what would you consider the length of time required for the surrounding parallelogram of which one side is 760 yards?—That is ascertained by a calculation.

305. Do not you at once see that this would be considered a serious objection on the part of any individual sinking a colliery, that years must elapse before he could avail himself of any of the production of the mine?—No; I think the moment they commenced in the line, they would be obtaining coal; it is the same principle as the present plan.

306. Is the Committee to understand that you contemplate driving more than one drift?—I advise two.

307. Are you aware that the seams in the north are generally about six feet perpendicular?—Yes, that is generally the seam they work; sometimes, I understand, they have worked a seam not more than 18 inches, and the men were obliged to lie upon their sides, which must be very prejudicial.

308. Are you aware that the weight of coal is generally averaged at one ton per cubic yard?—I have not considered that at all.

309. Supposing two drifts, three yards wide each, and the depth of the seam to be six feet, and each drift progresses three yards in the course of 24 hours, would you be able to excavate more than 18 tons in the 24 hours in each drift?—That is a question that I have not considered. I have devised a plan of working a mine, which would be perfectly safe, and have not considered whether it would cost more or less than the present plan; but upon the face of it, it appears to me to be a much cheaper mode than the present, and it has been considered so by many scientific men.

310. Then the Committee understand that the plan is proposed without any reference to the expense that might be incurred in the mine?—Yes.

311. In casting your eye upon the other plan, as drawn by Mr. Buddle, do you not perceive that it is in the power of the owner of that colliery to commence coal-working to an indefinite extent, almost immediately he is at the bottom of his shaft?—Yes, but at his peril he does so.

312. Did you ever understand that that was a judicious mode of proceeding to work a mine?—No, I did not.

313. Do you know that there are a great number of mines in the north that are not exposed to fire-damp?—I do, and believe the best coal is more full of hydrogen gas than the other.

314. Does that not depend upon the depth of the seam from the surface?—No;

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No; it depends upon the goodness of the quality of the coal. One of the witnesses yesterday told me an anecdote of a workman who went from a fiery pit to one that was not fiery, and he exclaimed, "I would rather be working at the other pit, as this is such hard work," the coal being really hard and gritty, and he found it very difficult to work; but it was less dangerous than the other, in consequence of being bad coal: he said therefore he would rather work in the fiery pit, on account of the ease with which he worked, than in this safe pit.

315. Are you aware that some of the best seams of coal are near the surface?—I am not aware of it; it sometimes happens, on account of the breaking up of the earth.

316. The Committee understand that you are not aware whether there are not seams of coal of the best quality entirely free from the fire-damp?—I should think that you would find all the best coal full of fire-damp; the more bituminous it is, the more fiery it is; then a great deal depends upon the management of the plan of the mine, some are on a better plan than others; this plan of Jarrow Mine is very bad.

317. Are you aware that many of the ancient workings are found in the present day entirely free from fire-damp?—I have not heard of that.

318. Would your plan require more shafts, or more expensive shafts, than the present plan of working collieries?—No, the same shaft would do; the plan does not depend upon the shaft, or the number of shafts.

319. Is it not the usual and best mode of working the coal, to drive out the levels before any coal is excavated?—I think it is the best, and I believe it is the usual course, to drive a head-way right on, according to the extent of the colliery, and that is my plan.

320. When do you get most coal; when driving the level, or when robbing?—When driving the level.

William Reid Clanny, Esq., M. D., called in; and Examined.

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321. YOU are doctor of medicine, residing at Sunderland, in the county of Durham?—Yes, I am.

322. Has the state of the coal mines in the county of Durham, for some years, occupied your attention?—It has, as it regards the interests of humanity, on purpose to endeavour to relieve the distressed situation of the miners. The explosions were and are so frequent, that I think every friend of humanity must regard it as his duty to be acquainted with the subject.

323. Can you state to the Committee at what period the subject first claimed your serious attention?—Previous to the year 1810 several explosions occurred in my immediate vicinity which drew my attention to the subject.

324. Can you allude to any of those particular explosions by name?—I am sorry to say that I cannot; I could if time were permitted.

325. Were the explosions to which you allude on the banks of the Wear, or what is commonly called the Wear Coal-field, or on the Tyne Coal-field?—Principally on the Wear Coal-field, and also on the Tyne Coal-field.

326. Subsequently to that period, have you personally been present about the time of the occurrences of such explosions in the neighbourhood of Sunderland?—I have.

327. Can you mention any particular events of that nature?—The time is so far distant that, except those occurring in Lord Londonderry's mines, I cannot particularize any one at this moment, and I prepared no minutes at all.

328. Were you one of a number of gentlemen who instituted a society for preventing the explosions in coal mines, about the year 1812?—I was.

329. Did that society continue its operations and proceedings up to the time of Sir Humphrey Davy's visit to the north?—Yes, it did.

330. Was the production, Sir Humphrey Davy's lamp, considered a sufficient reason for putting an end to the proceedings of that society?—I think, in the mind of the Rev. Dr. Gray, it was, but certainly in others it was not.

331. Did you see Sir Humphrey Davy early on his visit to the north?—I did.

332. Had you any conference with him on the subject of a lamp which might obviate the danger which resulted to the miners in working fiery mines?—I had constructed

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constructed a lamp so to isolate the light that danger could not occur, previously to Sir Humphrey coming to the north.

333. Can you, in simple terms, give to the Committee an idea of the form and rationale of the lamp?—It is upon record in the Transactions of the Royal Society. By forcing in a direct manner a current of air through a column of water to the light within that lamp, and the lamp was so constructed that it passed through another column of water in its current, which gave the safety to the upper and the lower part of this lamp

334. The flame being completely isolated at the same time in other respects?—Yes.

335. Had that lamp been in use in any of the mines prior to that visit of Sir Humphrey Davy's?—It had been in use in Lady Frances Vane's (now Lord Londonderry's) mines before that period.

336. Did you unite with Sir Humphrey Davy in any experiments upon lamps intended to effect the same object?—That question will be answered simply by giving a reply to the previous question; being absent, on professional duty, from my house, Sir Humphrey Davy called with Dr. Gray's eldest son, wishing to see me, and also to see this lamp; not finding me at home, he called a second time that day; hearing this upon my return, and being at that time much engaged, I took the lamp in my carriage and called at Dr. Gray's with it, and left it there for Sir Humphrey Davy to see it, as I understood he wished to do, being very desirous to give information upon the subject to everybody. Sir Humphrey Davy staid all night at the rectory; I believe he had that lamp in his possession till the following morning, when I being invited to breakfast at Dr. Gray's to meet him the following morning, I was too late, and found him experimenting upon this lamp according to the printed descriptions in the Transactions of the Royal Society; Sir Humphrey Davy soon afterwards, upon his return to London, presented the public with two safety lamps, nearly upon the same principle as my original one.

337. When you allude to "the same principle," do you mean that the construction was decidedly similar?—So similar, that instead of a pair of bellows he only substituted a forcing syringe, it being more simple; and substituted the flame of an oil lamp for a candle.

338. In his lamp, was the current of air meant to feed the flame forced through water?—Yes, in the first instance; the account of which is to be found in the Transactions, in the Annals of Philosophy, edited by Dr. Thomson.

339. At what period, subsequently, did Sir Humphrey Davy first produce to the world his gauze lamp?—A short time after this; finding that these modifications of the original safety-lamp were understood to be such, Sir Humphrey Davy, I believe, experimented upon the nature of the gasses found in coal mines, part of which I furnished him through a friend of his.

340. Sir Humphrey Davy's wire-gauze lamp was constructed upon a like principle of isolation, but was admitted to be a simplification of the application of that principle?—By many it certainly was, and by me among the rest, as regards isolating a light.

341. Having paid considerable attention to this subject, what is your individual opinion of the degree of protection afforded to the miner in working fiery mines, by the use of Sir Humphrey Davy's latest lamp?—Having carried the first light, with my own hand, into a coal mine infested with fire-damp, to the extent of 100 acres at least, and having studied the subject very minutely indeed, I am satisfied that, generally speaking, it is a very valuable instrument, from its portability and convenience.

342. Do any contingencies, connected with the operation of the miner in the North Coal-field, suggest themselves as likely to do away with the protection which is assumed to be obtained?—My own opinion is, and always has been, that under certain circumstances, it was and is not safe.

343. Have the goodness to state what those circumstances are under which you apprehend the lamp is no longer entitled to the appellation of a safety-lamp?—When the fire-damp, the light inflammable air or carburetted hydrogen, is in considerable quantity, and the currents of atmospheric air or drifts, as they are called, are very pure. I have seen, under similar circumstances, though not in a coal mine, the flame driven through the gauze, and such gauze as is in common use in Davy's lamps.

344. Which contingency, you are of opinion, might occur in a mine ventilated on the ordinary system?—I certainly am of this opinion.

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345. The light in that case, of course, was not surrounded by a glass chamber?—No, merely by gauze.

346. Did not Sir Humphrey Davy suggest that those lamps should be surrounded by a glass chamber?—In the first lamps he presented, he recommended the glass to be secured by some metallic substance, but afterwards he considered the gauze, having a certain fineness of texture, and the meshes of the lamp of a certain size, would be perfectly sufficient without anything else, except so much metallic substance as to keep it together in a cylindrical form.

347. Have any accidents come to your knowledge in which mines have exploded where those lamps were in constant use?—It has been frequently reported to me that such has been the case. I know one individual who declared to me that his own cousin had been destroyed by one of those lamps; he considered that when the inflammable air was very pure it burnt through the wire in a very short time; he was sensible of it, and mentioned, with tears in his eyes, that such was the case.

348. Do you know in what mine that accident occurred?—In one of Lord Londonderry's mines; the man's name is Elliott.

349. Did any other parties suffer at the same time as that person alluded to by your informant?—The case appeared to affect him so much that I did not press the question further, and I am not aware.

350. What reason was there to suppose that that individual had been destroyed through one of those lamps?—It was mentioned to me in a very few words, and I felt it an invidious task to make many inquiries; but he mentioned that the individual had only Sir Humphrey Davy's lamp, and after the explosion, he further stated, that the lamp was perfect after the explosion.

351. In the course of the discussions relative to the merit of Sir Humphrey Davy's invention, was not your name mixed up as being one of the parties who proposed to propound that principle to the public?—I had given a safety-lamp to the public, and it had been tried in 100 acres of inflammable air at the exploding point, before Sir Humphrey Davy gave any lamp to the community.

352. And was not there a warm controversy in the mining districts, as to whom the merits of the original discovery of the principle appertain?—Yes; and a question arose between Sir Humphrey Davy and his friends, and Mr. Stephenson, the celebrated engineer, in which I had no concern.

353. Will you state to the Committee what suggestions you have made as to improvements upon Sir Humphrey Davy's lamp?—I find that all flame must necessarily have an atmosphere of carbonic acid gas; we will take, for instance, a candle; the wick admits atmospheric air (as it is composed of gases) which heats the wick of the candle in such a manner, that it extricates thereby carburetted hydrogen gas belonging to the combustible substance, and in the process of heating it gives out at the light, giving part of the flame an atmosphere, if I may so call it, of carbonic acid gas: towards the top of the flame there is also an atmosphere of carbonic acid gas and nitrogen gas suspending carbon. If we take a metallic substance when the candle is burning, or apply the apex of the extinguisher, or the point of the snuffers, we shall find that we cannot touch the flame, it recedes immediately on all points, and this atmosphere is always so considerable in depth as to be at least equal to the meshes of Sir Humphrey Davy's lamp, and upon this I consider depends the safety of Sir Humphrey Davy's lamp, and not upon the cooling power of the wire, as has generally been supposed by Davy and others. Upon this plan I conceive it might be practicable to render any inflammable air safe when admitted to a close light-giving lamp; but as Sir Humphrey Davy's lamp is generally in use in coal mines infested with fire-damp, I considered it a better plan to apply this principle of safety to Sir Humphry Davy's, for this and several other reasons, than to give any new lamp, and accordingly I have done so in this manner: When Sir Humphrey Davy's safety-lamp is burning in common atmospheric air, the apparatus which I have devised is not called into action, but the moment inflammable air of any description is admitted to the flame of the lamp, a small piece of fine brass wire, which is passed transversely through the cylinder of wire-gauze in Sir Humphrey Davy's lamp, is burnt, when three or four cylindrical shields descend over the whole of the wire-gauze cylinder, and the flame of the inflammable air or fire-damp is instantly extinguished, but the flame of the oil lamp continues to burn. I have experimented with this safety apparatus in the presence of several scientific men, and it was also experimented with by Professor Johnson, of the University of Durham, before a large class of ladies

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ladies and gentlemen, to their entire satisfaction. I am of opinion that in some of our mines we have heavy carburetted hydrogen gas, or olefiant gas, as it is generally called. It is the opinion of a scientific friend that naftha is extracted from some of our coals. This new safety-lamp has been in use in several of our most explosive collieries.

354. Have you any certificate, showing that those lamps have absolutely been tried in any of the working collieries in the county of Durham?—I have one which I will deliver in.

[*The Witness delivered in the same, which was read, as follows*:]

" I hereby certify, that I have frequently used, in highly explosive atmospheres in coal-mines, the improved safety-lamp of Dr. Clanny; and my opinion is, no accident can ever happen, if safety-lamps be employed on his excellent plan.

(signed) " *Thomas Elliot*,
" 21 Feb. 1835. Master Wasteman, Pensher Colliery."

I have also a letter from the son of a very celebrated man, Mr. Easton, jun., which, with the permission of the Committee, I shall read.

[*The Witness read the same, as follows*:]

" Sir, " Nest House, April 20th, 1835

" Your improved safety-lamp was put into my hands, for the purpose of experiment, by my father. On the first trial, I found the wire sent with it to be much too strong, nevertheless it was speedily burnt asunder; but the weight of the extinguisher was not sufficient to draw the parts out of the meshes of the gauze. I went to Mr. Mountain's and got some finer wires (Nos. 40 and 45), and tried them, but with the same results; I then reduced the wires to Nos. 56 and 60, and found them to answer very well, so far as the fall of the extinguisher and the extinction of the gas was rendered certain; but I found that unless I had a large flame (*i. e.* a much larger one than is commonly used) in the lamp, it also was extinguished, although it had only to be carried about four yards from the place of experiment into a current of fresh air. You will see, by the degree of oxydation on the gauze when I return it, that the lamp has been fully tested, and found to answer the purposes for which you have designed it, so far as regards the extinction of the burning fire-damp; but required the interposition of a nail, or a small piece of wood, to prevent the sliding cylinder falling close down upon the bottom, thereby excluding the atmospheric air, and extinguishing the oil-lamp. Mr. Mountain will probably by this time have sent you a specimen of a new method of making lamp-gauzes, which I suggested to him some time ago; it is effected by means of stitching without the quadruple fold hitherto used. I have known gauzes, when much used in explosive atmospheres, crack or split on each side of the seam, owing (I suppose) to the oxydation caused by the great retention of the heat by the thick folds of the seam. Any communication on this important subject will much oblige both my father and myself.

" I am, sir, your's respectfully,
" *James Easton*."

[*The Witness produced his Lamp, which was examined by the Committee.*]

355. Are the Committee to understand that any considerable number of those lamps are now in use at Lord Londonderry's collieries in Pensher?—I am not sure how many are in use; I am not aware how many, because I have given the management thereof to another individual, who makes them.

356. Are you aware whether the party entrusted with the making of those lamps, has already made and sold a considerable number?—He has.

357. Have you heard from any individuals any doubts expressed as to the use of such lamps, under certain circumstances?—I never heard any doubt; but one gentleman, Mr. Foster, the eminent viewer at Haswell Colliery, stated, that he saw the propriety of the use of it, but that the miners were so negligent in general, that except there were some particular mode of enforcing from higher authority than even the viewers, they would be willing to run any risk rather than have any additional trouble.

358. Do you not consider that those remarks are applicable to every precaution that is suggested?—Quite so.

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359 Have your investigations led to any decisive conclusion as to whether the accidents which result in explosions are ordinarily occasioned by blowers from unbroken fields of coal, or from former wastes?—Certainly from all of these, and they may be considered as the chief causes.

360. Are you aware whether there are any mines in the county of Durham entirely free from fire-damp?—It runs in my mind that there are some in which explosions never occur, but I am not sufficiently conversant with the exact fact; it is most likely that there are.

361. Do you consider it probable that there will be the same accumulation of fire-damp in a mine of 30 fathoms from the surface, as in one quadruple that depth?—It has always been found that the finer the quality of the coal the more readily will fire-damp occur; the deeper mines, I think, have generally more fire-damp, particularly about Hepburn and those places.

362. Do you know of any mines not exceeding 50 fathoms in depth, where any inconvenience is found from the existence of fire-damp?—I am sorry to say that I am not a sufficiently practical man to answer that question, but I would say that I have visited a great many mines, and taken two different sorts of safety-lamps of my own construction, and with none of which have ever any accidents heretofore occurred, and that I would willingly descend to the most dangerous mine in the two northern counties (I speak of those because I know them,) with any of my lamps, at any time and under any circumstances.

363. As a medical gentleman of long experience, are you of opinion that the working in fiery mines is prejudicial to the health of the miner?—It is a most extraordinary fact, that our pitmen are the most healthy men that I know, though they are sometimes lamed and maimed, yet I think there is something conducive to health in respiring a certain portion of what we call fire-damp. I think that they, the pitmen, are peculiarly exempt from inflammations of the lungs, and especially consumptive diseases.

364. Then you give it as a decided opinion, that ventilation, by which, in this instance, is meant freedom from carburetted hydrogen, is not of essential importance to health?—Again there is another point involved in this, and a very important one, since the introduction of Sir Humphrey Davy's lamp we know that the pillars have been worked away in the coal mines, old workings have been explored, and several collieries that must otherwise have been abandoned for ever, have been worked to a very great extent; and I am satisfied, that the excess of foul air in such pits cannot but be detrimental to the workmen, for they have to breathe bad air, and sometimes work in it with Sir Humphrey Davy's lamp, when, they say, they are weakened by it. It is a peculiar affection, producing a sort of nervous attack, a loss of energy of the whole system. They are much enfeebled when compelled to work in such foul atmospheres as just hinted at.

365. But if the pillars are worked in due time, you do not consider that that would affect the health of the men?—No, not if well ventilated and well managed; and if the proprietors have equal regard to the health of the workmen as to their own emoluments; this becomes a very serious question.

366. You draw a distinction between abandoned mines, and the foul air which is found therein, and newly wrought mines, which are subject to fire-damp?—Yes, that is the point; because in the new ones, with a tolerable attention to the health of the workmen, the workmen enjoy excellent health.

367. In the course of your experiments, what would you say were the most decided indications of the existence of carburetted hydrogen, as perceptible by a working miner?—It depends entirely upon what instrument they employ for affording light, but they can ascertain what they call sulphur, because it has a peculiar smell.

368. Will you describe the smell as sulphurous?—Their impression is, that it is sulphurous, and they call it so; my impression is, that it is not of that nature which we should call sulphurous, but it is a very peculiar smell, something like the burning of water in steam engines, at times when water is burnt.

369. Is that invariable at present?—It is not invariable; sometimes it comes on in cases where large quantities of inflammable air are extricated in the mines; the miners who have been present at explosions, have not noticed anything very particular by which they were guided; it comes as rapidly upon them as a flash of lightning does in the atmosphere.

370. Is there a prevailing apprehension in the mining districts, that in cases of explosion, the greater number of lives are lost by suffocation, than by absolute burning

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burning or concussion?—It is generally supposed so; the returning draft is the danger; that is to say, when the inflammable air is exploded, then at that moment there is a partial vacuum formed in the mine, and the pressure of atmosphere being so considerable as 15 pounds to every inch, of course it comes back very suddenly and powerfully, and of this they are afraid after the explosion has taken place.

371. Is there any attitude that you would suggest to the working miner, as the best precaution against that draft, in case he is aware, by hearing or otherwise, of the occurrence of an explosion in a distant part of the mine?—I believe their own good sense has pointed out to them that which is best, to lie upon their faces, and to immerse their faces in the coal-dust, if they possibly can.

372. One advantage that would naturally suggest itself from the use of your lamp would be, that in case any sudden infusion of inflammable air took place whilst the miner's eye was on a remote object, the light might be extinguished, and thus give him warning of the presence of that of which he was before ignorant?—Decidedly so, as the light would appear to be extinguished the falling down of the shield; because the new lamp is so constructed, that it remains burning at the wick only; but it is advantageous that they should know the dangerous position they are placed in.

373. After the shield of protection has fallen, are there apertures by which sufficient light would be obtained to enable the miner to retrace his course out of the mine?—There are two apertures, and so large as to permit the head of a considerably sized pin to pass through.

374. Is that sufficient to enable a miner to retrace his course out of the mine?—At the moment at which he observes that he is in darkness, it is his duty then to remove the lamp, because the air is bad, and to retreat upon the other men further back; and the plan which is adopted is this, that when the shield descends, he immediately retreats a step or two, and lifts up with his finger and thumb the shield, and if the flame continue at the oil-lamp, he retreats from that part of the mine by the light; and the same thing occurs should it be extinguished, he must also retire upon those men who are behind him.

375. In the range of your medical experience, have you anything to suggest as to accidents which may have occurred from the ascending or descending of the mines?—Such as breaking the ropes and unlocking the apparatus. I have frequently observed, and I have taken a great deal of pains in discussing with men at the pit-mouth, where there are iron plates, and having shoes with iron nails, are, I think, in imminent risk; and I have suggested to them to have a rope so long as to be fastened about their waist, and the other end attached to the beam above their heads, so that should they miss their footing, or by any accident be pushed towards the pit, they may not fall down.

376. Are such accidents as these of a banksman, as he is termed, falling into the pit, of frequent occurrence?—I think not of frequent occurrence, but I have often been very much alarmed for their safety.

377. Does any thing occur to you connected with the general comfort and safety of the miners, in addition to what you have already stated to the Committee?—I am of opinion that the proprietors of mines are most attentive to the comforts and welfare of the pitmen, since the Act of Parliament passed some time ago.

378. To what Act of Parliament do you allude?—By which they were not restrained as to the persons from whom they purchase their necessaries.

379. You allude to the Act against the payment of wages in goods, abolishing the truck system?—Yes; to my knowledge it was one of the most valuable of Acts; for since that time there have been no complaints whatever.

380. Have accidents frequently happened from men being drawn over the pulleys?—Yes, frequently.

381. Does it occur to you that there is any simple mode of obviating this?—No, my friend, Mr. Wilkinson, who has been a witness before this Committee, and I, have discussed this subject together, and I believe Mr. Wilkinson knows something valuable upon the subject.

382. Have you ever offered those lamps to the Hetton Company?—Yes, I have.

383. To the viewer?—Yes; I think he is favourable to my plan; and from the communications I have received, I would mention another, Mr. Storey, who, I think, is favourable to it.

384. Who is Mr. Storey?—He is a viewer in one of the collieries towards the south of the county of Durham.

385. Has he expressed himself favourable to the improvement?—He has.

 386. Have

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386. Have you any suggestions to make to the Committee as to the texture or construction of the wire gauze ordinarily in use?—I believe that in some cases the mode in which they are worked together is such that they project the warp or woof more than they ought to do; that the meshes are not equal throughout, and that this might be remedied by passing the wire-web through cylinders, or in some other manner as Mr. Easton junior mentions, which will make them perfect.

387. Are the coal-owners in the habit of employing individuals to clean the lamps when left by the miners returning from work, previous to their descending again in the following morning?—Yes; and in some of the more extensive mines there are some men employed in making those lamps, and very inferior ones they are in many instances.

388. In the brushing and cleaning those lamps, are the meshes liable to become enlarged?—Yes, they are.

389. Without minute investigation and care, may not such a circumstance be attended with great risk?—Most undoubtedly.

390. It is your opinion, then, that the gauze ought to be so constructed, or woven, as to prevent one part being detached from its original position to the other?—Most undoubtedly; it should be very perfect indeed as to the meshes.

391. Were you at all aware of the fact mentioned by Mr. Easton, jun., of the gauze being liable to sudden fracture on exposure to heat, or change of atmosphere, at the seam end?—I have heard it more than once mentioned, that after explosions in coal mines, lamps have been found torn in their texture from top to bottom, but whether it arose from the bad state of the wire-gauze lamp, or from the agency of fire-damp, they could not inform me.

392. But you can easily conceive that if the wire be of an inferior quality, and consequently be injured in the seaming, it may be liable to such fractures?—Undoubtedly it is.

393. And that this may account for accidents otherwise unaccounted for?—I have no doubt that it does.

394. You stated that the pitmen were for the most part extremely reckless of accident?—Yes, in a general way; as men accustomed to danger, working as it were upon a precipice, they are reckless.

395. Has there been no means adopted in order to make them more cautious, or to make them pay any penalties for want of caution?—In the management of mines this is a very important point; the coal-owner knows very little about the detail, unless he be a very humane or active man; it is left entirely to the viewer, and the viewer employs certain individuals, called deputy viewers, overmen and wastemen, to superintend the general state of the mines, and report accordingly.

396. And is it their object to see to the security and safety of the men, as far as they can, or is it the viewer's business to go and examine them once a day?—It is the business of the viewer to go down very frequently, which he does.

397. Have the number of accidents decreased, or have they been pretty much upon the average, from the period of the use of Sir Humphrey Davy's lamp?—It is upon record, that taking the average of 10 years previous to the introduction of Sir Humphrey Davy's safety-lamp, and allowing one clear year for its introduction, that in 10 years after it was properly introduced there had been double the number of accidents, and at least double the number of deaths, than in the 10 years previous to its introduction.

398. Is there any cause assigned for that increase?—It has been acknowledged to me by several viewers, that from the comparative safety afforded by safety-lamps, the men were placed in a new position altogether, and were employed in working mines that had been abandoned, and availing themselves of the pillars, they allowed the roof to fall down upon the floor of the mine; sometimes they prop up the roof when they wish to have a circulation of air carried on through that part of the mine.

399. Do you conceive that a great proportion of the deaths have been from accidents of that kind, and not from the damp?—It is stated to me, that the fire-damp was the exact cause; the men were placed in a new position altogether, that is, according to the new mode of working with safety-lamps, they were liable to greater accidents. It is just and fair to the viewers, and all gentlemen concerned, to make this remark.

400. Do you suppose, in consequence of this lamp having been placed in their hands, that they have been induced to work in places where they would never have ventured to do so before?—Yes, I think so.

401. And

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401. And to that you attribute the increase of accidents?—Yes; I think men are liable to accidents in those places where there is an accumulation of fire-damp, and in other places foul air; for instance, men working near to other mines, where there may be an accumulation of fire-damp, they may cut an aperture through the workings at places in which they are not afraid of fire-damp bursting in upon them. Under such circumstances risks are increased.

402. Do you think there have been more or less accidents by explosion?—No doubt of it; double the number, and double the number of deaths.

403. May not the working miners have increased in number of late years?—The number of deaths has increased, taking into account the increased number of pitmen.

Martis, 23° die Junii, 1835.

JOSEPH PEASE, ESQUIRE, IN THE CHAIR.

John Martin, Esquire, called in; and further Examined.

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404. WE understand that you wish to make some additional observations to those which you offered the Committee at its former sitting, on the ventilation of mines?—Yes.

405. Will you state what the nature of those observations are?—They are relative to a question which arose as to the length of time it would take to form a gallery round the whole of the work.

406. The question was put by the Committee under the impression, that however desirable the plan, the time required for its execution would be a barrier to its adoption?—Yes; it appeared to be a very reasonable one.

407. Has the subject as to the time to be occupied in laying out a field of coal according to your plan, had your further consideration?—Yes.

408. What is the result of that consideration?—This plan [*handing in a plan.*]

409. You have there a plan changing the direction of the works from those contemplated in the former plan?—In a certain degree, but keeping the same principle exactly; only that I can get a greater number of men to work at the same time on this second plan than I could before, since I have doubled the quantity, and can increase it to any number.

410. This plan is intended to meet the objection as to length of time during which the owners would be deprived of profit in mining undertakings?—Yes.

411. Will you have the goodness to explain, as simply as possible, the nature of the plan now introduced?—It is simply by altering the situation of the up-shaft and making an additional headway in a diagonal line, so that I can place any number of men to work that may be required: but it would be better to read this paper, which will explain it fully.

(*The Paper was then put in, and read, as follows:*)

PLAN for ventilating Coal Mines.

Upon explaining my method of working a coal mine on the 18th instant, an observation was made by the Chairman as to the length of time that would elapse during the formation of the ventilation gallery, before the main body of the coal could be worked. This objection appeared to me to be so forcible, that I have re-considered the subject, and beg to produce the following plan, which, while it maintains the same principle of ventilation, will allow the coal to be worked without delay.

Supposing the proposed quadrangle to be on an inclined plane, the downcast and upcast shafts should be at the opposite angles, the downcast shaft being placed at the lowest part of the mine. When the two shafts are completed, the galleries or headways should be cut in right lines until they meet at the intermediate angles: by these means four different sets of men would be working at right angles with each other, and would consequently accomplish the grand quadrangular gallery in half the time that the way I before proposed would occupy. Besides these rectangular headways, I further propose that there should be a diagonal headway from shaft to shaft, dividing the mine in half, as this would allow two sets more men to work at the same time; and if more are required,

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any number of men can be set to work in this diagonal headway at intervals of 20 yards. The foul air should be drawn off during the formation of the headways, by means of a brick wall connected with the regulating ventilator. As soon as these headways are finished, the two shafts should be braticed, (to make each serve as two), and the ventilator should be placed at the up-shaft, when the air would enter the down-shaft, sweep along the gallery, and up the up-shaft: the same at the opposite side of the mine. The coal should then be cut from the extreme corners diagonally, until the shafts are reached.

Respecting the time occupied in forming the quadrangular gallery, one mile square, supposing four sets of men were to work four abreast, and to cut four yards progressively in 24 hours, the gallery would be completed in one year four months and eleven days, exclusive of Sundays and holidays.

Anthony Winship, called in; and Examined.

Anthony Winship.

412. WHAT is your trade?—I am a wasteman.

413. What is the duty or office of the wasteman in a colliery?—It is to see that the mine is kept well ventilated with pure air, to keep the workmen safe.

414. Have you been long employed in the coal mines in the county of Durham?—Yes; do you mean in the present occupation?

415. In coal mines generally?—All my life; ever since I could do anything.

416. What age are you?—I am 47 years of age; and ever since I have been 10 years old I have been so employed.

417. Have you any sons employed in the mines?—Yes, one.

418. In what capacity or situation is he?—He is what we call a deputy; that is, a man that puts in timber for the safety of the mines, and to prevent misfortunes.

419. Are you at present occupied in Lord Durham's mines?—Yes.

420. Are those mines subject to foul air or fire-damp?—They are.

421. Can you state to us at what time they are most subject to fire-damp?—We generally think, when the wind is from the south, that the hydrogen gas is more quick and severe than at any other times.

422. More so in summer than in winter?—Yes.

423. How do you account for its being more so in summer?—The earth is warmer. In the winter season we generally think that the atmosphere, being much cooler, is more beneficial to the mine.

424. That is your experience, that in hot weather you are more teased with foul air than in winter?—Yes.

425. What is the name of the pit in which you are at present engaged?—I am engaged in six or seven different pits.

426. What is the general depth of those pits?—Some 100 fathoms; some 80; some 70: from 70 to 100, all of them.

427. Are you working the same seam in all these pits?—They are all working the same seam at present.

428. What is the name of the seam which you are now working in those shafts?—We call it the Hutton seam.

429. Have you ever worked on the Main coal seam?—Yes, I have.

430. Have you ever worked on the Low mine?—Yes.

431. Have you worked in the Maudlin?—Yes.

432. Which of those seams do you consider most liable to be foul?—The Hutton seam, which is the lowest.

433. How do you account for the Hutton seam having more fire-damp in it than the other seam?—I cannot answer that.

434. Do the seams vary very much in the extent of fire-damp?—They do vary in some points a little, but not very much; there is a little fire-damp in all.

435. Do they vary in the extent of the fire-damp; is there much more in some than in others?—Yes, there is more in the Hutton.

436. But you cannot account for that?—No.

437. Now, we understand, that your particular care is to see that the mines under your charge are properly ventilated?—Yes.

438. Will you have the goodness to state what the nature of your work is during the day?—Yes.

439. Explain it then?—The nature of my work after descending the mine, is to proceed from one part of the workings to another, to see that there is a proper air-course kept open for the ventilation of the men who are at work.

440. Do you generally go into the mine with the first or the earliest shift in the morning?—Yes, always the first.

441. At

441. At what hour of the morning do you generally descend?—Three o'clock in the morning.

442. Do you descend at the same hour generally?—Every morning at the same hour.

443. How would you detect the air-course being out of order, or the mine ill ventilated?—If we found any fault in the air-course we immediately employ a number of additional men to assist us in putting it right.

444. But we should like to know how you find out that it is wrong?—By walking through it every day, and watching the different parts.

445. Is there anything offensive in the smell, which would indicate the presence of foul air?—We know it by the smell; but then I am afraid it would be too late to answer as a warning; we always take the precaution of travelling with the safety-lamp.

446. Would the smell precede it for a very short time or a very great length of time?—When the hydrogen gas is there, you can smell it. When you have the passage quick, so that you might come in contact with it with the lamp, hundreds of times the safety-lamp has exploded internally.

447. In those cases you presume that a candle would have fired the whole mine?—Yes, I have no doubt of it.

448. Was you a wasteman previous to the introduction of Sir Humphrey Davy's or Mr. Stephenson's lamps?—Yes.

449. How did you manage to work foul pits under those circumstances?—There were frequently misfortunes, more so than there are now. There is not a tenth part now that there was then.

450. Do you mean to say that you are not working with more foul air in a mine than you were before these lamps were invented?—Yes, I dare say there is much more now.

451. Had you accidents in Lord Durham's collieries before these lamps were invented?—Yes, we had.

452. Have you had any accidents since?—Yes, there have been accidents since, but not by the safety-lamp.

453. Do you recollect when the safety-lamp was first introduced in Lord Durham's collieries?—About 20 years ago; I cannot exactly say.

454. About the year 1815 or 1816?—Yes, I think it was, but I cannot exactly say.

455. Now do you recollect the explosion at Newbottle, on 2d June 1815?—Yes.

456. Can you tell us whether the safety-lamp was in use in Newbottle pit at that time?—I dare say not.

457. Now do you recollect the accident at the George pit in 1819?—Yes.

458. How many men were lost then?—Eleven, I believe, men and boys.

459. Any injured?—No, not any injured.

460. Now was the safety-lamp in use at the George pit at that time?—No, it was not; the safety-lamp was in circulation then, but not used.

461. Do you recollect an accident at Measham colliery in October 1821?—Yes.

462. Now do you know whether the safety-lamp was regularly used at that pit?—I do not know; I was not employed there.

463. Then the George pit blew up again in 1824, did it not?—To the best of my recollection, I think there has only been one misfortune at the George pit.

464. Now the Charles pit, at Lumley, has that ever blown up?—Yes, there was an accident there.

465. Were there any men lost?—No; I think one died.

466. Was the safety-lamp in use at the pit at that time?—Yes; part of the men were using the safety-lamp, and part not.

467. Was you wasteman in that pit?—No; I was not there.

468. Do you know how the accident happened?—I cannot exactly answer that, how the accident happened.

469. Do you know, yes or no, whether the man had a safety-lamp that lost his life?—I dare say the man that lost his life had a safety-lamp.

470. How do you suppose, in your own mind, the accident happened?—The blast came from another part of the mine, where the candles were used.

471. They had been working with candles?—Yes.

472. Then

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472. Then if the blast came from where they were using these candles, were the men using those candles blown up?—No.

473. How do you account for the air being ignited at a distance?—I cannot tell; I cannot give an answer to that.

474. Have your mines been better ventilated of late years than they were before?—Yes; there has been a good deal better ventilation within the last 10 years.

475. Since the introduction of the lamps?—Yes.

476. Do you attribute the decrease of accidents to the use of the lamps, or the better ventilation?—From the improved ventilation, as much as the use of the lamps.

477. What reason have you for supposing that there have been fewer lives lost in mines since the invention of these lamps?—We consider them a perfectly safe thing, when they are well managed, except in cases of accidents, and accidents will occur in times.

478. Now will you give us an instance of an accident occurring with these lamps?—I cannot name one.

479. Have you ever heard of one?—Yes, I have heard of one, but whether it is truth or not, I cannot say.

480. Have you ever heard of mines blowing up, in which they were regularly used, and well managed?—Yes.

481. Have you ever heard of their being mismanaged?—I have heard so; but whether it was true or not, I cannot say.

482. Did you ever catch a man with his Davy unscrewed?—Never; there is a very strict law for the punishment of any person who unscrews his Davy.

483. Did you ever hear of a man or boys having been sent to the house of correction at Durham, for having done so?—Yes.

484. Did you ever send any from your pits?—Not that I can recollect; there might, but I cannot say.

485. Is it common where the safety-lamp is used. Is it common to work with candles?—No.

486. The object of the safety-lamp was to prevent candles altogether?—Yes.

487. Do you generally forbid candles being used?—Yes; we do not use one at all.

488. In the event of such a thing being done, would the man be subject to punishment?—There is no person allowed to go down with a candle in some of the pits.

489. Does it ever occur unknown to the overman of the pits, or persons like yourself, for others to take candles down and make use of them?—Never.

490. Of course, if they did, they would be punished for so doing?—Yes.

491. Are there no candles used in your mines?—In some there are, and in some none; not in some pits.

492. What is the reason that they are used in some pits?—For working the old pillars, that is, the coal left when the mine is first opened.

493. Is it absolutely necessary to use them in that sort of work?—Yes.

494. You could not do without them?—No.

495. You say there have been great improvements in the ventilation of mines?—Yes, very great.

496. Can you state any of those improvements?—Yes.

497. Be so good as to state what you consider the greatest improvement in latter times, which have been made in the ventilation of coal pits?—The mode of ventilation that is used in coal pits is, suppose there is a field of coal lying before you, a waggon-way is laid to the shaft for the purpose of conveying the coal to the centre, and the air is taken along this waggon-way, and when it comes to the top of the waggon-way where the men are employed, it is divided into each part of the workings, north and south. It is what we call split or divided air.

498. That is in the case of one shaft?—Either in one or two shafts; for one shaft there is a separation down the middle, it will answer for either one or two shafts.

499. Then the air so divided, is completely distributed over the mine?—Yes, right along where the men are employed, and back again, so that it fetches all the foul air away, and leaves the mines free where the men are employed.

500. How long is it since that improvement has been adopted?—Not more than eight or ten years. It is the greatest and best improvement that ever was known.

501. Then

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501. Then from place to place, you intersect the air-coursing by stoppings?—Yes; we have done away with all trap-doors, which used to be a great nuisance in mines.

502. Then in that case, how do you regulate the air-coursings?—By taking it along each waggon-way right in a direct line to the mine, it is divided in the top and goes along each, and there is what we call stoppings, which turn the air used at the mine to the extremity of each side, and it never interferes with the workings at all of the mines; then it comes into the hands of men in my situation, and we conduct it to the up-cast shaft, where it is again emitted.

503. Now were you in the habit of working the pillars at all, before the introduction of this safety-lamp?—We were in some cases, but not in others.

504. Do not you think, without the introduction of these lamps, immense tracts of coal in the county of Durham would have been entirely lost?—I do; there is no doubt of it.

505. Do not you consider these lamps have enabled you to work where otherwise you never could have done so?—I think so; or else there would have been great hazard of men's lives.

506. Did you ever work by steel-mills?—Formerly; we have none of them now.

507. What light did you get?—Rather a brilliant light at times, but not a constant light.

508. Did you ever know a fire taking place with a steel-mill?—I have heard of it, but I was not there.

509. Have they not been used within the last 20 years?—Yes.

510. Did you ever hear of a fire taking place from a steel-mill?—I heard of a case where four or five men were lost by an explosion arising from the use of a steel-mill, but it is hearsay, I was not there.

511. Indeed, no man was left to tell?—No.

512. It might have happened from something else, you cannot tell?—Yes, it might have happened from something else.

513. Now have you any complaint to make against the men, for their carelessness in the use of these Davy safety-lamps?—I have not.

514. Did you ever see them blow a flame through the gauze to light their pipes?—Never.

515. You never saw a man with his lamp taken to pieces?—Wherever we consider there is danger, there is not a man allowed to go down with a pipe.

516. Do you consider generally that smoking a pipe is productive of danger?—Where there is a gas it is considered dangerous.

517. It is not essential to the comfort or health of the men, that they should smoke?—No.

518. Where the choke-damp is, they like to smoke?—No, not they. I do not think it does them any good at all.

519. Is it not a common occurrence for a man to take off the top of his lamp where there is no danger?—There is a person appointed at the bottom of the pit, who takes charge of all the lamps.

520. How do you account for the accidents that happen by explosion where lamps are constantly used?—They may be caused by an accident.

521. Do you think that is generally the case, or is it through the carelessness of the workmen?—It never happened where I am.

522. You never was in a pit where any persons were burnt?—Many times.

523. Have you ever seen any lamp which you consider superior to those introduced 10 or 15 years ago?—No, I have not.

524. Have you seen an improved lamp?—No.

525. Do you use a lamp with a glass chamber or not?—I never use one with a glass.

526. Do not you suppose that a man may keep his lamp filled with inflammable air till the wire is quite burned through?—As soon as there is anything of the kind, we remove the person away from that situation to where he is safe, and where the lamp is not on fire.

527. But may not the lamp for some time be out of sight of the miner; may he not be working with his back to it?—But there is a man going about every ten minutes, examining the works.

528. Those are the deputies and overman and wastemen?—Yes.

529. Where the lamp is used without a glass, is it not liable to get filled with coal-dust?—Yes; and they are cleaned every day.

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530. Do not the men remove the gauze when they find it filled with dust?—No, for there is a proper person who looks at these lamps, and they are locked, so that the man cannot open it.

531. Are they invariably locked in the best pits, and the best management?—Yes, always.

532. Supposing a man taking advantage of what he considered a safe state of the mine, and having a pipe with him, and lighting the pipe by blowing the flame through the gauze, may it not have happened that the blower has come upon the mine before he is aware of it, and he may blow up the mine in that way?—He is not allowed a pipe.

533. Not in the safe parts of the mine?—Yes; in the safe parts the lamp is not used.

534. Are there not some parts that are doubtful?—Where there is any doubt, or the least shadow of danger, the man is ordered to take a lamp, and continue the lamp.

535. May not a man be safe for a year, and on the next day, by coming near the old working, or by a fall of the roof, may there not come a strong blower on the mine suddenly?—Yes, that has been the case.

536. In that case may not the mine be blown up without anybody knowing how it happened?—The present mode of ventilation does away with that fact which used formerly to be the case; that used frequently to be the case.

537. How long is it since this improved mode of ventilation was originally introduced?—About eight or ten years ago.

538. Do you think every mine in your neighbourhood is well ventilated?—I do not know; I cannot say that.

539. How do you account for this accident at Wallsend the other day?—I do not know.

540. Did you ever see the seaming of the wire gauze broken at the back of the lamp?—I have seen the wire gauze broken in the seaming, but there is a proper person appointed to examine it.

541. But did he break it, or was it broken by the man who brought it to him to clean?—I do not know; when a man breaks it, he carries it to this person to examine, and he examines the lamp, and if he finds the least hurt in the world he takes it away and replaces it by a new one instead of it.

542. So that if the wire gauze has got pulled or stretched or broken, it is immediately removed and a new one substituted?—Yes.

543. Supposing a fall in the roof of a mine, and a collection of inflammable gas above the ordinary level of the roof, how does your new mode of ventilation remove that? Suppose there is a fall in the cavity above the level of the ordinary roof, which would be filled by inflammable air, how does the new mode of ventilation take that away?—The new mode is, that the current of air is so fresh upon the inflammable air, that it carries it away.

544. Is not the current of air lower in the place than that which is filled with inflammable air?—It is lower.

545. Suppose a fall of four or five yards or more?—In that case there are boards put up, which throw the current of air into the aperture.

546. What becomes of the boards, they could not be placed in the waggon-way?—There is never anything falls in the waggon-way, it lies in a narrow compass.

547. But there is sometimes a fall?—Yes, there is sometimes a little.

548. Do you think explosions could take place from a miner's pipe?—I cannot say, I never heard of it.

549. Have you seen a steel-mill?—Yes.

550. Do you not think the sparks are much hotter than the fire of a pipe?—I do not think so.

551. They are white heat, are they not?—Yes.

552. That is hotter than the tobacco in a pipe?—I cannot say anything about the sparks of tobacco.

553. Then I understand your opinion to be, and the result of your experience to be, that the original safety-lamp is perfectly a protection from danger in fiery mines?—Yes, I believe so.

554. You make no allowance except in cases of accident from sudden breakages or destruction of these lamps?—I believe it quite safe, except some such accident takes place.

555. Suppose

555. Suppose the case of a fall taking place on a lamp and smashing it, would that cause an explosion?—Yes, it would.

556. Do you think the men more unhealthy that work in fiery mines, than those that work in others that are free from choke-damp?—I cannot say.

557. You have noticed no difference?—No, I have not.

558. Do the men change their clothes on coming out of the pit?—No; they never change their clothes till they get home.

559. Do they live at great distances from the pits generally or not?—Some do, and some not.

560. What is the greatest distance?—Three miles some.

561. And they invariably walk home just as they come out of the pit?—Except in very wet places.

562. They are usually clothed in flannel, are they not?—Yes.

563. Do they change when they are sinking in a wet place?—Yes.

564. How many hours do they continue working when they go down?—Some six, and some eight hours.

565. Have you no regular fixed time?—There is a regular fixed time in some pits and some not.

566. It is all piece-work?—Yes.

567. How often do you change, where you have a relief of men in the 24 hours?—They work generally 12 hours. In some cases they have two sets of men, and in some only one set of men.

568. When a man comes up from a pit, how long does he stay before he goes down again?—It depends on how long he is about his work; a strong able-bodied man is eight hours down, and he will be the rest of it up. If he is 10 down he will be up 14.

569. But you do not expect him to remain longer than eight down?—Yes.

570. You call on him to be down more than that?—Till he has done his work.

571. Is that the case throughout all the pits, the piece-work?—Yes, all the pits.

572. Have you any cases of men refusing to go down a pit because it is so foul?—No, we have not.

573. Did the men ever come out because a pit is so foul?—That has been.

574. Did you ever try to force them back again?—No.

575. You never compel a man to work where he is not safe?—Quite the contrary.

576. That is, you always encourage the men to leave those parts of a mine which you consider unsafe?—They have particular orders, if anything occurs in the absence of those who have charge of the mines, that they immediately desist from working and come home.

577. What children have you generally employed in the mines?—A great quantity; in our concern perhaps some hundreds.

578. As many children as men?—No.

579. How long do the children work?—They stop 12 hours.

580. Then they work longer than the men on an average?—Yes.

581. They work by the day?—Yes, part of them work by the day; but some by what they can get by working piece-work.

582. What are the ages of the youngest that are employed?—Ten years is the youngest that go down.

583. There are others employed on the surface of the pit?—Yes.

584. At what age are they employed there?—It is 10 years before we employ any of them.

585. What, at the surface?—That is the youngest.

586. Do they go down as early as 10 years old?—Yes.

587. They are generally employed in light work?—Yes, such as opening doors and getting horses, and so on.

588. Do they attend any school?—When they have a holiday, Sunday schools and different places.

589. When you say 12 hours, do you mean 12 hours besides meal time?—There are no regular hours for meal time, they catch it when they can.

590. Is it common for them to take any food with them down into the mine?—Yes.

591. They have an opportunity of taking that in the course of the working?—Yes.

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592. But there is no cessation of the works of the pit during meal time?—No.

593. Are there any women employed?—No, not one.

594. Not on the surface?—No.

595. What is the posture the men generally work in, are they not obliged to lie down very often?—They generally work standing or sitting.

596. But do not they sometimes work on all fours?—Yes, when they are undermining the coal.

597. Frequently on their knees?—Yes.

598. Do they use gunpowder to blast the coal in your county?—Yes.

599. Does that affect the ventilation of the mine at all, do you consider?—Not at all; there is that power in the air that sweeps it away immediately.

600. Do they hole the coal with gunpowder?—No.

601. You do not find the least difference with regard to ventilation, whether they use gunpowder or not?—No.

602. There is a viewer over you, I presume?—Yes.

603. You report to him the state of the mine?—Yes.

604. How often?—Three or four times a week, or if all goes on well, twice a week.

605. You have no stated periods?—If the thing goes on well, twice a week, if there is occasion, twice a day.

606. Does he go down the pit frequently himself?—Yes.

607. How often?—Some weeks he is down two or three times a week, some weeks four or five times a week, and I have known him down much oftener.

608. How long do you continue down?—Seven hours.

609. And this you do every day regularly?—Yes, excepting Sundays.

610. And if anything was amiss, would the viewer visit you immediately?—Yes, immediately.

611. You know of no instance of his neglecting his duty in that respect?—Never.

612. Do you find a mine more liable to explode on Monday mornings than on other days of the week?—We always find it cooler on Monday mornings than on other days.

613. Can all the children read that are in your employ?—I would not say that all of them can, but the greater part of them can.

614. Does it sometimes happen that the air goes up one pit and the other is reversed?—No, never.

615. Does anybody ever go down the pit on Sundays, for the purpose of examining that all is going on right?—Yes.

616. Is that common?—Yes, very common.

617. Is that always done, or now and then only?—Always done, regularly.

618. That does not take any length of time?—No.

619. Do you go down yourself?—I do not go down on Sunday mornings, the overman and overlooker go down.

620. That practice is general in all the mines with which you are acquainted?—Yes.

621. It is never missed?—Never, they always go down.

622. Your furnace for ventilation is at the bottom of the pit?—Yes.

623. You force some of the air through the furnace, and some past the furnace?—Yes.

624. Which is the best way?—Part through the furnace, and part past the furnace.

625. Passing the furnace is the most economical way; which is the most effectual; is the strongest current through the furnace or passing by it?—If I find it necessary to make an additional road, so as to make a smaller current through and past it.

626. Is not the current stronger when the whole of the air passes through the furnace, instead of some passing over it?—It depends on the quantity coming.

627. If there is a sufficiency coming for the furnace, could you not make the furnace force a larger quantity?—In some cases we could, and in some we could not.

Ralph Elliott, called in; and Examined.

628. ARE you employed in the coal mines belonging to Lord Londonderry at Penshaw, in the county of Durham?—Yes, I am.

629. What situation do you hold in those mines?—I hold the situation of overman and manager of the waste connected with it.

630. How long have you worked in the coal mines?—Above 42 years.

631. In various capacities?—Yes.

632. Have you any family?—Yes, I have five sons and two daughters.

633. Are your sons at work in the coal mines also?—I have three of my sons in the coal mines at present; one has been a short time absent from the colliery; but they have all been brought up as colliers.

634. Are his Lordship's mines at Penshaw what are called fiery mines?—I scarcely know how to answer that question.

635. Are any of them fiery?—They are all fiery to a certain degree. The reason why I feel diffident in answering that question is, I am apprised there is a great difference in magnitude between mines that are fiery, to a lesser or larger extent; but the Marquis of Londonderry's may be considered as a kind of fair sample; some less and some more so, but still they are fiery mines.

636. That is to say, that there are other mines much more troubled with the damp, but still that these mines are liable to be infested with it: you have a great deal of this damp, though there are some worse?—Yes.

637. Have you ever had any accidents in those mines from explosion?—Am I to speak as to Penshaw colliery.

638. Yes?—Then in the course of the 12 years I have been there, we have not had one accident.

639. Have any of the mines around you belonging to his Lordship ever exploded?—At one of the pits at Rainton; I think there was an explosion there.

640. Which Rainton, middle, west or east?—Those are the places that stand on the surface: when I speak of Rainton colliery, I mean the whole of Rainton liberty together.

641. Do you know the Plain pit at Rainton?—Yes.

642. Was there ever an explosion there?—Yes.

643. Do you recollect how many lost their lives there, men and boys?—I think 59; but I am not positive: I have the account by me.

644. Was that in the year 1823?—I suppose it was.

645. Do you know whether the safety-lamp was in use at the Plain pit at the time of that accident?—I know that the safety-lamp was in use in the Plain pit at that time; but I am not certain whether there was not one department in the pit that were working with candles at the time.

646. Do you recollect hearing, from persons competent to know, how that accident was supposed to have occurred?—I cannot say that: I went into the mine myself in the getting of the men up, and I was with all the parties; and I never heard that it could be accounted for.

647. You were with the parties who went to extricate the bodies of the men who were lost; but you never heard how the accident was supposed to have occurred?—No.

648. Would it not have been natural to have inquired how that accident occurred?—I dare say it was, and many times I have asked the question. It is a very general thing, when an explosion of any kind takes place, for the viewer or manager to apply immediately to the persons who have escaped, and who are the best adapted to give information: the very first thing they do is to inquire how it has happened, where it is, and so on.

649. That is quite essential, in order to discover whether any of the men can be recovered alive?—It is.

650. Then you never heard what answer the viewer or manager received as to that accident at the Plain pit?—No, I did not.

651. Were all the men in the pit lost at that time?—No.

652. Did you ever ask any of the men that were saved how the accident occurred?—I cannot recollect that.

653. Is that the only accident that you can recollect in the Rainton liberty?—Not without I was to turn to my account; my memory does not serve me with any further information at present.

654. You know the new pit at Houghton-le-Spring?—Yes.

655. Do

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655. Do you recollect how many men were lost there?—I saw it in the list; but it quite escapes my memory about that accident.

656. Do you recollect any accident at the Dorothea pit at Newbottle?—What time was it?

657. About the year 1821; June 26th?—I would wish you to understand that I have only been 12 years in the county of Durham: my practice and application previous to that were in the county of Northumberland.

658. What pits did you work in at Northumberland; was it on the Tyne side?—I commenced work at Walker's colliery first.

659. Did you ever work in Jarrow colliery?—I did not.

660. Did you ever work in the Row pit at Harrowton?—I did not.

661. Were you ever near or connected as an overman or wasteman with any of the mines when they exploded?—I think the best way to answer that question will be, by stating whether I was personally present at any accidents; that will be the best way to answer it in the first instance.

662. Were you personally witness to any accidents?—I think the first one was at Lawson Main colliery, under the owners of Walker colliery.

663. Were any lives lost there?—One.

664. Was that an explosion or a falling in of the earth?—It was an explosion.

665. Were you down in the pit at the time?—I was down in the pit at the time.

666. Were you there merely as a hewer, or as overman, or wasteman?—At that time the pit was not in a safe state.

667. Were you a hewer, overman, deputy or wasteman at that time?—I was acting in the capacity of wasteman at that time, but had no charge.

668. What year was that?—1802.

669. Will you explain to us the circumstances under which that accident took place?—The circumstances under which that accident took place was in consequence of a creep having taken place, which stopped the air-course; and several persons were employed to get the air-course opened, so as to get the ventilation restored. We were using at that time steel-mills as the only kind of precaution.

670. The steel-mills was the only precaution you could use then in foul mines?—Yes, and there was nothing else down the pit but steel-mills.

671. You are satisfied that there was neither lamps nor candles down the pit?—None; it was before the time of the safety-lamps.

672. Proceed with your account of the accident?—I believe the way the accident occurred there was, they were working through a creep, which had been occasioned by the weight above pressing upon the pillars, and sinking them into the hill, by which the ventilation had been destroyed in that part of the pit. They were passing through certain avenues of a seam in the old course, into another portion of straight which had been sunk; and the foulness or hydrogen gas was emitting or oozing out of this part. The viewer and wasteman had just been examining the state of the pit themselves, and, after they had been in the very worst place where the men were, they returned to the bank. This wasteman, on his returning again to where the men were working, approached this place where there was a very strong oozing out of hydrogen gas and at the steel-mill there.

673. Did an explosion immediately take place?—The hydrogen immediately ignited, but in consequence of the creapt state of the pillars, what we call the blast did not take place; the gas oozed out and fired the coal, which continued burning. The persons who were further in the mine than this place, finding a kind of concussion by the igniting of the gas, became alarmed; I was one of them; all proceeded to get out, and when we got thus far, the place was all in a flame. The hydrogen was blazing in the cavities which were spoken of by the last witness, and we had to pass beneath it in an ignited state. One man in coming out, not knowing exactly the path that we had to take, as we had neither lights nor mills, nor anything else, turned too soon to the left-hand, and lay there, the pit was closed up, and he lost his life.

674. Then he was not absolutely burned or destroyed by the concussion, but became stupid and insensible?—Yes.

675. Now do you know of any explosion, either on the banks of the Tyne or Wear, in cases where the safety-lamp was universally employed?—Universally; I must have that term properly understood before I answer it. As I hinted before, one pit may be divided into three or four divisions in its workings. Two or three of those divisions may be, as it applies to those divisions, generally and universally working

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working with lamps, and another division may be working with candles. Now, in answering the question, I suppose I should have to omit any portion of the workings where they were universally working with candles.

676. My question applied to any pit, or section of a pit, in which nothing but lamps were introduced?—I had a nephew in the section of a pit where nothing but lamps were used, though candles were used in another part.

677. Now will you explain your own impression as to the way in which that accident happened?—I was not working in the pit at the time.

678. Then what have you heard from authentic sources on the subject?—I perhaps saw more, for as soon as I knew the explosion took place, (I was not living at a great distance from the pit,) I immediately went and descended with the viewers down to the place where the accident happened, and I can give no account how this happened; I have no idea, and the parties themselves, I believe one or two of the persons who came out, could give no description how it happened.

679. What were the sort of lamps that were used?—Sir Humphrey Davy's safety-lamps.

680. Where did this accident happen?—In this very pit which we have heard this morning spoken of, Mr. Russell's Church pit.

681. Did you find the pit foul when you entered it?—Not for a long way in.

682. You visited the spot where your nephew lost his life?—I visited the spot, and was the first person who went to him where he was lying.

683. Was he severely burned?—No, he had died by suffocation or choke damp.

684. Is that your general impression, that men more often perish from the after-damp than the fiery ignition?—I dare say three to one.

685. Have you not seen men severely burnt?—Yes, but in going in mines after a blast, I have frequently found men to have suffered two to one more by suffocation than by absolute burning, I might say three to one.

686. Is there any peculiar appearance about the faces of those who die from the after-damp?—Yes.

687. State what the appearance of the body is?—That is, when they die by suffocation?

688. Yes?—When they die by suffocation there is nothing particular about the body more than one may imagine of a person who has slept away. There is no kind of strangling in his appearance; not frequently so. But those that die by the blast, sometimes they are all shattered to pieces.

689. Struck against the sides of the mine?—Their limbs all broken to pieces, and their heads likewise.

690. On those men that are blown to pieces there is also on their persons and clothes no appearance of burning?—Yes.

691. In one case the man is destroyed by absolute concussion, in the other by the choke-damp?—It is possible that a man may be thus blown to pieces by a blast occasioned by the ignition of gas, and yet the fire never to have touched him.

692. In many cases men are destroyed by the motion of the air striking them against the sides of the mine, when they have not suffered from the effects of the choke-damp or the fire; in other cases men are not moved at all, but they die from want of air where there is choke-damp?—Yes, two or three to one. Both those that die by concussion and by suffocation are three to one to those who are burnt to death.

693. When a violent explosion takes place, the system of air-coursing is entirely destroyed?—Not always so.

694. Generally?—That depends very materially as to the quarter or district of the pit where it has happened. It has been known in many cases that an explosion in one part of the pit has taken place, and in another part of the pit, the ventilation having been kept up, the parties themselves have not known that the explosion has really happened.

695. Is it not accompanied by a loud subterranean sound generally?—In certain parts of the workings.

696. Is there not a rumbling sound, like thunder at a distance?—Sometimes; most generally it is so; but some pits are so particularly circumstanced, that workmen may lie at obtuse corners away from the noise, and they do not hear.

697. Do you agree in what the last witness stated as to great improvements having

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having taken place within the last 10 years in the general system of ventilating mines?—Do you mean that generally?

698. Yes?—I would rather only answer it particularly as to the knowledge I have within my own experience.

699. Do you consider that his Lordship's mines in the neighbourhood of Rainton and Penshaw, and the liberties surrounding, are better ventilated than they were 10 or 12 years ago?—Yes.

700. In what way have they improved the system of ventilation?—The system by which we have improved the ventilation is not so recently as 10 or 12 years; I mean, as last witness deposed, by dividing air. I perfectly recollect, in the pit of which I gave an account, in which a person lost his life, when that pit was commenced on the system of split air in certain portions of the workings. I believe, at the colliery of which I am about to speak, the system has been more generally acted on within 12, or 14 or 15 years.

701. By the general adoption of this system, is there any difficulty, with proper care, in well ventilating every mine?—It is a system that may be applicable to mines, generally speaking, but perhaps in some cases cannot be applicable; but as far as ventilating mines perfectly, I believe any mine may be done so with to a certain extent. I mean in old coal, a difficulty lies in ventilating mines properly in taking out the old pillars of the old works.

702. Then on the old system, not having the plan of splitting the air, and wanting the lamps, the pillars were in many cases left unwrought?—Perhaps in some cases, it might be so at Walker colliery; but at the date of my former observations, when I was there, pillars were wrought then to a certain extent.

703. Does it not require improved ventilation to work the pillars; does the working of the pillars now more than formerly require a better ventilation than before they were worked?—Yes.

704. Are you in the habit of talking with the workmen in the mines generally?—Yes, I go about and examine them.

705. What is the opinion of the workmen about ventilation compared with some years ago?—I can only speak with reference to the men over which I am placed.

706. As to the general body of workmen in your district, not taking an individual mine, but taking the general run of mines?—I scarcely know how to speak generally. The workmen themselves can scarcely form an opinion; if I was to hear 10 of them speak on the subject I could scarcely be able to form an accurate idea. Perhaps if I was to inquire at Lord Durham's, I might hear a different account to what I hear in my own.

707. These men are constantly changing their places from one mine to another?—Yes.

708. Is it not the case that the workmen change their place of employment?—Yes.

709. They are generally acquainted with what takes place in a district?—Perhaps not; I do not know that; the managers of collieries are. I mean such as overmen and wastemen, not viewers.

710. Is not ventilation, which affects in so very important a degree their health and lives, a thing that engages their immediate attention?—It is not so much a public question as I could wish it was.

711. Your men are generally engaged by the year?—Yes.

712. How often do they change their working places?—In the same pit the men change from one of these districts I have spoken of, once a quarter, but still in the same mine.

713. Do the same men continue to work in the same pits generally from year to year?—Yes.

714. Supposing in the case of a colliery where the lamps were not positively required, where the mine was in a tolerable state, supposing in that case it was the law that lamps should be used whether they were required or not, what would be the disadvantage of using those lamps compared with candles? Speaking now with regard to profit and expense, supposing there was some law by which lamps should be used in that district, what would be the disadvantage in these collieries where the lamps are not positively required?—The work would be impeded.

715. To what extent would be the disadvantage as compared with using candles?—I can scarcely say to what extent; but there is one thing I would just observe on the subject, that if lamps were to be used generally speaking in opening of mines, and the working of a colliery generally speaking, I question whether or not

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there would not be more accidents occurring. For this reason, if a person taking out the pillars to let the roof come down, if they were to have a lamp, it would be more dangerous than to have a candle lighted.

716. How do you manage that same operation, where the air is so bad as to require the use of lamps?—Those are the only difficulties I spoke about.

717. There are some collieries where you still use candles?—Yes.

718. What would be the disadvantage if you were compelled to work by lamps?—That is one of the reasons which I have been endeavouring to state, namely, that it would prevent the work being so expeditiously done.

719. Where you can use candles and are forced to use lamps, I want to know what would be the positive disadvantage of using them?—I scarcely know how to answer that question.

720. You have stated one disadvantage in drawing the props and timbers?—Yes.

721. Is there any disadvantage in fitting?—No, not so much as to the pulling as to hewing; as where the lamps are used they cannot blast the coal.

722. I suppose a man works always by the ton or by the piece in these collieries?—Yes, it is by the score of crores.

723. Supposing a collier is working with candles or oil lamps, and the state of the mine requires you to substitute the safety-lamps for the candles or common oil lamps, how much more would you give for the score of crores than you did before?—It would in some cases mutilate very strong coal, and render it less valuable.

724. To what extent?—I am not prepared to answer to what extent.

725. Are the wages of the men increased, supposing the circumstances of the mine require you to use the safety-lamps?—They are in certain cases increased, when they are prevented the use of powder.

726. How much?—If they do not use powder they have to knock it down with hammer and wedge. As to the difference of price, I suppose from seven to ten per cent.

727. You think that the average, taking all the operations of the mines, where you are obliged to use lamps instead of candles, would amount from seven to ten per cent.?—As it applies to the labour, composed of strong coal and working in the whole.

728. What other respect does it apply to?—To the mutilation of the coal.

729. It breaks the coal more?—Yes.

730. Do you consider that the use of wedges to bring the coal down, breaks it more than gunpowder?—In some kinds of texture of coal; certain kinds are better worked with wedges than powder.

731. I take the district in which you are employed yourself; do you consider coal is more broken small by gunpowder than it is by the use of wedges?—I think not; some of the seams differ from other seams.

732. You say gunpowder does not break the coal more than wedges?—My answer was, that the gunpowder would rather mutilate the coal more in some seams.

733. In other seams quite the contrary?—Yes.

734. Have any more accidents than those you have named come under your personal observation?—I do not recollect at present.

735. Ever since you have known Lord Londonderry's collieries, has Sir Humphrey Davy's lamp been constantly in use?—Yes; I have been 12 years there, and it was in use when I first came to the Marquis of Londonderry's.

736. And what is your own opinion of it, do you think it answers the purpose of safety from what you have seen?—In all cases since the Davy-lamp has been in use, with the Davy-lamp in my hand I have always considered myself as safe in an explosive atmosphere as I am sitting here, with proper precaution.

737. What do you mean by proper precaution?—In the first instance I mean this, that if I had the Davy-lamp in my hand, as soon as I approached an atmosphere of the hydrogen gas, that is the foul part of the mine that will ignite, so soon as I do that, if I am watchful and attentive to it, I have always considered myself safe with it, in many hundreds of cases, while I could keep it and draw it easily back again from the place where it thus ignited.

738. Now supposing you were walking at the top of your speed through headway courses, would the lamp be safe in foul air?—I would not do so.

739. Then you think you are not safe with a Davy-lamp walking fast in an explosive atmosphere?—I have always hesitated in using it thus myself. I always

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contrive to get something around the back part to hinder the pressure of the air on the lamp when I am obliged to do so; but it is seldom the case that I am obliged to walk through an explosive atmosphere. The men are not required to go where there is such an explosive atmosphere.

740. Did you ever know the case of a mine exploding from a perfectly good Davy-lamp, unless some accident happened to make the orifice larger in the gauze?—No, I do not.

741. What makes the difference whether you move that lamp fast or slow through an explosive atmosphere?—In the first instance, I conceive that when a lamp is still, in an explosive atmosphere, it seems to indicate to me that there is less pressure from without. I observe that pressure carefully by taking it back from the place softly, rather than quickly.

742. Do you think that the ordinary pressure from the removal of the lamp with rather quick motion, would that endanger an explosion of the gas in an atmosphere of hydrogen gas?—I have never known an instance of it. I have always used the precaution myself, and where I have had anything to do with ordering others, I have in every case impressed this on the workmen.

743. Have you given the instructions with the lamp?—I am not sure of it.

744. Then moving the lamp slowly is a fact arising from your own observation and experience?—From apprehensions of the danger of it.

745. Do those apprehensions exist generally among the miners in your part of the country, or are they confined to yourself?—I have endeavoured to make the impression as much as I can, on every man to take it back cautiously.

746. Do you happen to know what other overmen think with regard to this point?—So far as I know any men who know anything about it, they use this precaution.

747. You think it necessary for the safety of that lamp that it should not be moved quickly from place to place in an explosive atmosphere?—That is my opinion.

748. You were employed in collieries before this lamp was known?—Yes.

749. Do you consider, from all you have been able to ascertain, that accidents have increased or diminished since this lamp has been in use?—I am sure I cannot exactly state; I have not looked at the accounts; I cannot say exactly. I have known before very heavy accidents, and I have known some since.

750. But you are not able to state whether you think that the number of accidents have diminished to any extent or not?—I am not able to say that.

751. But from all you know of its practical use, what should you be inclined to suppose, that accidents ought to diminish or ought not?—My opinion on that subject is, that they ought to diminish, provided the lamps be properly taken care of.

752. Now when you say that, are the pitmen, those whom you know, liable to be very careless in the management of the lamps; does it often occur that they lose the screws, or anything of that sort?—It is not to be doubted that there has been a carelessness in some places, and accidents have occurred in consequence.

753. And you think that many accidents that occur with that lamp, occur in consequence of the carelessness of the pitmen?—I believe many accidents have occurred from that cause.

754. Do you know at all of pitmen ever lighting their pipes by means of blowing a flame through the gauze?—Not by that means: I have seen a pitman do that at the expense of his work. If it was known that he was to do so, he would be suspended. I have seen cases of their drawing the flame into the pipe. The way they do it is, they lay the lamp on one side, and they put the pipe on, and draw the flame through the gauze.

755. And smoking pipes are not allowed in the pits; do they forbid it generally or not?—Wherever there is imminent danger the pipes are prohibited.

756. But generally speaking, do you think the pipes likely to produce mischief; you cannot always clearly ascertain whether there is imminent danger or not?—I think it would be as well if pipes were not allowed to go down where safety-lamps are to be used.

757. Independent of safety-lamps, are they likely to do any danger in the pits?—No.

758. Do you not think that an immense quantity of coal has been wrought, as in the district with which you are acquainted, which could not be wrought at all, except from the introduction of the Davy-lamp?—Yes; I believe there is much coal got which could not have been got without that or some other invention.

759. I suppose

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759. I suppose the quantity of coal wrought in your district has very largely increased within the last few years?—Yes.

760. The quantity brought to bank?—Yes.

761. Supposing the present quantity of coal had been wrought under the old system, before the introduction of the Davy-lamp, do you think that accidents would have been much greater than they are?—By far.

762. Indeed it would have been impossible to have worked some of these pillars?—Yes.

763. You have given the subject of accidents in coal mines great consideration for the last 30 years?—Yes.

764. Have you any suggestions to offer which may tend to the diminution of those accidents?—I am not prepared at present; it is a very important thing to do.

765. Have you turned your attention very much to it?—I have been for 30 years employed in an official character.

766. Have you anything you wish to suggest as to the prevention of accidents?—I would make free just to name one thing, which might be of some importance in the prevention of accidents in coal mines. I think, if public attention was more particularly called to the subject, and something done to get the best system of ventilation made known to the country: I think it might be of use if it were called more to public attention, and rendered more generally interesting: something of the kind, it is my opinion, would be of service.

767. In some collieries that are worked with lamps, and some with common candles, what would be the effect if this were the law of the land, that in any part of a mine which had explosive mixture, that the magistrates should have power to order that nobody should use anything but Davy-lamps, under heavy penalties, whether required or not; would that tend to diminish accidents in those mines?—I do not think it would; for this reason, that where large works are going on in three or four certain districts, and while one of those districts are working with the utmost precaution with the Davy-lamp, the other districts may be working with candles; and if they are all at work with the Davy-lamp, it does appear to me, that the workmen, for the want of knowing where there was danger, and where there was not danger with the Davy-lamp, would not attend to it. I am apprehensive the principle would not affect the workmen generally to such an extent as to render them careful in some places.

768. In seeing the Davy-lamp where the explosive mixture is dangerous, does not the appearance of the lamp indicate danger?—It does so; but the impressions are not yet rooted deep enough in the general mind of the workmen as to that.

769. Supposing the workmen were obliged, under certain penalties, to use the Davy-lamp, would not the overman take care that they should use the lamp constantly?—The overman does that under the present circumstances. It has been stated that the lamps are locked, and so on; but when the men find the air is good, they know well enough there is no need of them; and they are less careful in those places than in others.

770. Does it not often happen that a mine explodes from the sudden appearance of a blower of gas; does it not become inflammable, and accidents happen in that way?—Yes.

771. If they were to use the Davy-lamp in those cases, would there not be less danger?—That is, if they were to use the Davy-lamp always.

772. Yes, where there was danger in any part of it?—It does look like it; it appears so from that question; that is, that an accident happening by the candle, would not then happen in that way; but it is another question whether they would not happen by the carelessness of the workmen.

773. In addition to the affliction which every master must feel in losing his men, are these explosions not always the occasion of serious loss to the owner of the colliery?—Very much so.

774. Can you conceive any authority calculated to make the master miners and viewers more careful than they are now?—I am sure I do not know.

775. Can you conceive anything more likely to call the public attention to this subject than an investigation by the Parliament of the country, the results of which will be printed and distributed among the public?—I think it will go a great way to do that; I cannot foresee any other mode.

776. Do not you think it will have the effect of calling the attention of scientific men to a subject which they have overlooked, not living themselves in the imme-

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diate district of the mines?—Yes, that is what I observed before; if anything could be done to do that, it would be of use in the mining department.

777. Can you conceive any better means than the Government of the country undertaking the investigation, and giving the result to the public at large?—I do not see which way it would be better done, without there was something offered to scientific men to turn their attention to the thing.

778. Do you know of any cases in which real meritorious inventions have gone unrewarded?—No.

779. Do you know whether Sir Humphrey Davy received anything voluntarily from the coal-owners for his invention?—I am not certain of that.

780. Do you know whether Mr. Stephenson received anything as an acknowledgement for his services?—I am not aware of that.

781. You are not aware that handsome presents were made to each of those individuals?—I believe there was, but from whom I cannot say.

782. Are the men acquainted with the principle of Davy's lamps, and why it is more safe than the common lamps?—I do not understand the question.

783. Do they understand the principle why they suppose them safe?—No.

784. Have any attempts been made by the masters to make them acquainted with the principle of the lamps?—All that the master has done, I believe, is to impress them to pay attention to the lamp; I believe it will be impossible in a scientific way to make them understand the nature of it.

785. Do you think it would be impossible to impress on the men the nature of it, and the reason why it is safer than the candle?—That could be easily done, why it is safer than the candle.

786. Have you a Mechanics Institution at Chester-le-Street?—Yes.

787. Are you a member of that institution?—No.

788. Do you know anything of its operation?—No.

789. Nor the number of its members?—I believe it has been very much in a declining state lately.

790. Do you think the men would attend to anything like a familiar lecture given in the neighbourhood, on the advantages and dangers of the safety-lamp; would they take the trouble of hearing such a lecture?—I cannot say, some might.

791. Have any directions been given with the safety-lamp?—Every man who gets the safety-lamp, the viewer impresses upon him the necessity of paying attention to it.

792. Are there no printed directions with it?—I do not recollect any; I recollect once getting a copy of them, but I do not remember seeing one of them for some years back.

793. Did you ever work by the light of a steel-mill?—Yes.

794. Which gives the best light, the steel-mill or the Davy-lamp?—The Davy-lamp is steadier, and more certain than the steel-mill.

795. Which affords the best light to work by?—The Davy-lamp.

796. Now admitting the Davy-lamp to be secure against accident, do you think it very far inferior to the common candle to work by?—It is rather inferior.

797. Do you not think it a very desirable thing that something should be invented by which the same security could be obtained as by the Davy-lamp, with a much better light to the workman?—We find the light, for most of purposes, has answered; but if the light with equal safety could be increased, it would be better.

798. Would it be a matter of great importance or not?—It might be beneficial in this point of view: there is in seams that have different stones when they work with the Davy-lamp; there an increase of light with equal safety would be of benefit to the mines.

799. But, generally speaking, you think the Davy-lamp affords sufficient light for working the coal in your district?—Except in the case I have mentioned.

800. Supposing another lamp was invented, by which a better light was given, would not that tend much to diminish the frequency of the men taking off the gauze from the lamp; if they could be offered as good a light by something equally safe, would not that tend to diminish the frequency of accidents?—If you could make a lamp to give them more light, still they would feel inclinable to do these things.

801. If they could have equal light, they could have no wish to do so?—Certainly, it takes away temptations of that description.

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802. The general reason of their injuring the lamps is to afford themselves more light?—Sometimes it is done by idleness, sometimes wilfulness. I believe there was an accident occurred some years back entirely by a person's wilfulness, although he was warned. I cannot state the case just now.

803. Now do you use the lamp with a glass chamber around the gauze, or without it?—Without it.

804. Do not you conceive it would be much safer, especially in exploring the mine, to use a lamp which would allow of being quickly moved, having the advantage of a glass chamber?—I do not understand the question with respect to the glass chamber; I have seen one of the lamps.

805. You have seen a lamp surrounded by glass?—[*Producing one to witness.*] —Yes.

806. Do you not think that a lamp so surrounded with glass would bear being moved swiftly in a foul atmosphere?—I do not think that lamp would burn in an explosive atmosphere.

807. What is your reason?—I have merely that opinion; I never had but one to burn in my hand, and that never in an explosive atmosphere.

808. Do the pitmen reside generally near the pit?—It happens sometimes they do, close to the pit, or sometimes away from the pit. The general average of their travelling is about two miles.

809. Do they change their clothes when they come out of the pit immediately, or do they go home in the same clothes in which they have been working?—In wet mines they change them.

810. Where do they change them?—In the first instance, the pitmen work with their clothes off, with nothing but flannel drawers and a kind of body shirt on, &c.

811. Do they go home in those things, in these same flannel drawers and shirt, or do they change them on coming out of the pit before they go home?—Generally speaking, they go home with them, inasmuch as where they are all dry pits.

812. In wet pits?—In wet pits they put them off there.

813. Are they dried, or any thing done to them before they use them again?—They tie them up in a string and take them home with them, and dry them there themselves.

814. Have you ever seen a lamp improved by Dr. Clanny of Sunderland?—I have had one of them down the pit.

815. What is your opinion of the merits of that improvement?—I think it is an additional safety to the Davy-lamp.

816. Has that lamp been tried in an explosive atmosphere?—Yes.

817. Have you found that the wire became fused, and the lamp was immediately extinguished?—Yes; it does not extinguish the lamp directly, it allows time to remove into a purer atmosphere.

818. You said you thought there was some danger in a current causing a greater pressure on the lamp; do you not think that the danger may arise in this way, that the flame of the lamp might be brought in actual contact with the gauze, or even pass through it?—I think, I expressed myself thus, perhaps not properly, that when the lamp is in a still atmosphere, I had no apprehensions of its danger, but the danger was either in a current of explosive atmosphere pressing heavily upon the lamp, or carrying that swiftly through an explosive atmosphere.

819. Do you not think that the danger arises rather from the flame of the lamp being carried by the current against the side of the gauze, or even through it, than by the pressure on the lamp; do you not think that the current may force the flame through?—From what I have observed, I should say, that the current blowing upon it carries it against the gauze. That is the reason I have my apprehensions.

820. The current carries the flame in contact with the gauze, and that is the cause of the danger?—Yes.

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JOSEPH PEASE, ESQUIRE, IN THE CHAIR.

Ralph Elliott, called in; and further Examined.

Ralph Elliott.

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821. IN the course of the last examination you gave an opinion favourable to the improvement made in the lamp by Dr. Clanny; have the goodness to state what experiments you have tried with that lamp to justify such an opinion?—The lamp improved by Dr. Clanny, was put first into my hand by a person that had made it I understood, that is, the mechanic who had managed it; he went down with me into a mine of explosive atmosphere, and I must say, to my surprise, as soon as we entered into the explosive atmosphere, my not knowing just the principle on which the thing was intended to act, immediately the cylinders dropped down, and nearly extinguished, and in two or three seconds would have extinguished the lamp, when I drew back from the explosive atmosphere and put them up again; that is the reason that makes me think that it is an improvement. In Sir Humphrey Davy's lamp, without that improvement, it is not impossible but that a person who is using those lamps may, before he is aware, have gone some distance into an explosive atmosphere; one cannot, when travelling with a lamp, going imperceptibly into an explosive atmosphere, perceive just at the moment when the ignition takes place within the lamp; but in this improvement, as soon as ever ignition takes place unawares, as it was to me, immediately the wire on which the cylinders were suspended fused, and they dropped down, and I came back to a more pure atmosphere. Sir Humphrey Davy's lamp, if it was intended for it not to be in a continuous flame, then this is an improvement on it, inasmuch as it gives sooner warning to the person who has it when he enters an explosive atmosphere; and, in the next instance, will involve this principle, of preventing workings of all kinds that have ever been carried on in an explosive atmosphere, if that lamp was to become general.

822. That is to say, that the moment the shields drop, it is impossible for the miner to pursue his work?—Yes.

823. Looking at that lamp as supplying a diminished quantity of light, and the possibility of the shields getting fixed so as not to act immediately, or the springs deranged, do you see anything, as a practical man, that ought to prevent the general use of such an improved lamp in very fiery mines?—In case of the springs getting deranged, or the cylinders not falling in their proper place, that renders that improvement under that accident useless; but the lamp under which that improvement is made, is as perfect as it was previous to the improvement.

824. Will it give the same quantity of light as the lamp commonly in use?—The lamp will give the same quantity of light, but not to such an extended degree; that is, it will not expand so wide.

825. Do you consider that objectionable?—For the purposes that I have very repeatedly used it for, I have felt it of no inconvenience; and where we have it in practice in the travelling of our waste, employed by our wastemen, I hear of no inconveniences arising from the diminished expansion of the light.

826. Then the specific value that you attach to the improvement, consists of the use that may be made of it in exploring, rather than the general adoption of it by the working men?—They are particularly useful for that purpose, and I can only say, that as I have tried the experiment no further than that, I would decline answering the other part of the question; I do not see any reasons why it should not be so, but I have not tried the experiment.

827. Did the Committee understand you to say that this lamp, supposing the shields not to act, would be still as safe as Sir Humphrey Davy's?—Yes.

828. The Committee are quite ready to hear any suggestions relative to the ventilation of mines; you were questioned as to the improvement which had taken place in your time in the ventilation of mines; can you state any of those to the Committee?—I would rather deliver in any evidence upon that subject, which I may have to give, in writing.

[*The Witness was directed to do the same.*]

Mr. *Nicholas Wood*, called in; and Examined.

Mr. *Nicholas Wood*.
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829. ARE you engaged professionally as a collier viewer in some of the largest collieries in the counties of Northumberland and Durham?—Yes; I am viewer for Lord Ravensworth and partners' collieries, and I am engaged in Gateshead Park and Tyne Main collieries.

830. Are you the author of a work that has been given to the public on Railroads?—I am.

831. Will you have the goodness to state to the Committee your idea of the coal stratifications of the North of England, as productive of carburetted hydrogen gas?—The coal in the North of England generally lies in seams, varying from three feet to six feet in thickness; it consists of different varieties of coal, some considerably more bituminous than others, which may, perhaps, be classed into bituminous or caking coal, and slaty, or coal that does not cake.

832. Do you consider the bituminous or caking coal, or the slaty, to generate greater quantities of carburetted hydrogen gas?—The bituminous coal.

833. Are those stratifications liable to interruptions or dislocations?—To considerable dislocations and interruptions, both in number and extent.

834. Have you ever observed a greater or less generation of carburetted hydrogen, where those interruptions or dislocations take place?—In answering that question, I do not know whether it would not be necessary to enter into an explanation of the manner in which the gas exists in the coal, in the first instance, and then to point out the way in which those dikes and slips affect that gas, and bring it in contact with the miner, in the operation of working the coal.

835. The Committee wish you to proceed to give your opinion of how the carburetted hydrogen gas is suspended in the coal stratification, and the alterations which take place in consequence of those disruptions and dislocations?—In the operation of working the coal, we find in practice a continual hissing sort of noise in the coal, especially where it abounds very much with inflammable gas. Lately, by means of cutting coal into very thin slices, and magnifying those slices, it has been ascertained that the coal is very porous, and that those pores contain bitumen distinct from the chemical composition of the coal itself; and in those pores also, I believe, the gas is contained, either in a state of very high compression, or it has been surmised that it exists in a liquid state, which contains a still greater quantity in a smaller bulk. I have brought sketches of some of those coals that have been sliced and highly magnified, to enable the Committee to observe the nature and appearance of those pores. The very dark appearance in these specimens is the bitumen supposed to be in the cavities, and the round spots are the cavities where it is supposed the gas exists. This mode of examining the structure of coal was an invention of Mr. Witham's.

[*The Witness produced the Drawings, which were inspected by the Committee.*]

836. The Committee observe, that upon these sketches are certain numbers; are those the numbers by which you are familiar with the different specimens here pourtrayed?—Yes.

837. Will you, in the course of your examination, allude specifically to the drawings by their number, and describe them in succession?—I can do so; I should observe, that these drawings which I exhibit are from a paper read by Mr. Hutton, of Newcastle-upon-Tyne, which has not been published, but which, I understand from him, he intends to publish shortly.

838. Do you suppose that there would be any objection to copies of these drawings being made, in furtherance of the object of this inquiry?—I should think not.

839. The Committee understand these drawings to be correct copies of the appearance of certain portions of coal, sliced as you have described, when submitted to a strong magnifying power?—Mr. Hutton stated them to me to be correct copies.

840. Will you have the goodness to proceed to describe each drawing separately, and in numerical order?—It must be observed, that the description I give is from reading the paper of Mr. Hutton, not from my own knowledge. This drawing, No. 1, is stated to be a slice of a coal from Heaton colliery, in Northumberland; and the appearances show that that coal contains a considerable number of pores, and that coal is a very bituminous coal, yielding a considerable quantity of gas.

841. Do you find quantities of gas in proportion to the size and number of cavities?—

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ties?—The experiments have not been sufficiently numerous to establish that fact. No. 2 is a specimen of slaty coal, in which the cavities are almost entirely extinct; and this is a coal that does not yield much gas, if any. No. 3 is a specimen of cannell or splint coal, in which there are very few pores; and I believe that cannell coal does not evolve anything like the quantity of gas that the No. 1 does.

842. Do you know from what mine the specimen of cannell coal is taken?—I do not. No. 4 is a specimen of anthracite or stone coal, from South Wales, in which there are a considerable number of pores; and I know, from my own experience, that that coal in some mines produces a considerable quantity of gas. This porosity of the coal, I think, corroborates what we find in experience in working the mines: in the course of working, we find the gas issue from innumerable pores over the whole surface of the excavation; that is one mode in which the gas is evolved in the mine, and the force with which it is evolved depends very much upon the depth of the mine, and other circumstances respecting the dikes that I have mentioned as crossing the coal strata almost in every direction. I have a working plan of Killingworth colliery here, which will at once explain to the Committee the dikes which have been met with in that colliery.

[*The Witness produced the Plan, which was inspected by the Committee.*]

843. The lines on the plan that you produce, the Committee understand to designate those interruptions in the coal stratifications of which you have already spoken?—Yes.

844. Some of those throw the seams of coal to a higher and some to a lower level, as regards the surface of the earth?—They do.

845. What is the size of this mine?—This plan is four chains to an inch, and the workings cover about 800 acres, worked by two pits.

846. In addition to the emission of gas, in consequence of the porosity of the coal to which you have alluded, do you ever find considerable escapes of gas from the roof, or from the floor or thill of the seam?—We do.

847. What is the nature of the roof or thill in the mine to which you have alluded?—The nature of the roof varies considerably. Having spoken of the gas being produced by those pores, the slip-dikes, which are cracks in the strata, are sometimes filled up entirely, and sometimes they are not; the whole strata consists of alternate layers of sandstone and shale; where the shales abut against each other on the two sides of the dike, the dike is filled up entirely; but where the sandstone abuts against sandstone, there are very often cavities in the line of those dikes; those slip-dikes, then, act as tubes or pipes to collect and convey the gas extricated from the coal to great distances. The gas is extricated from the coal into these cavities in the dykes, and they convey the gas as gaspipes to different parts of the coal field. When one of those dikes is met with in the working, independently of having to contend against the extrication of the gas in the coal itself, the gas in the slip-dykes is thrown out in very considerable quantities; and as those fissures in the slip-dykes are generally narrow, and the gas comes out in a small space, it often issues with great force, and is then known by the term "blowers," and the size of the cavity and the degree of pressure to which the gas within is subjected, regulate the force at which it issues from that blower. I have mentioned already that the coal strata consists of sandstone and shale; sometimes the immediate cover or roof of the coal is sandstone, and sometime shale. The shale is very compact and quite impervious to the air, and in coal working, where the roof is shale, there is no discharge of gas from the roof, it entirely exists in the coal itself, unless any break of the strata is produced by accidental causes, and a communication is made with the more porous roof, or with one of those slips that I have mentioned. In several instances the roof of the coal is sandstone, and sandstone being more porous, and having more fissures in it, the gas in that sort of roof is more liable to be discharged from the sandstone than from the roof of shale. The same takes place with respect to the thill of the coal. Seams of coal very often have thinner seams near to them, below or above; if the thill of the coal be shale it is only when that shale is broken through, and a communication is thus made with the lower beds of coal, which is often the case in practice, that, as before stated, independent of the supply of gas from the seam which is working, the additional supply of gas from the scare underneath is encountered; and I would observe that this is peculiarly the case in working pillars, the coal being entirely taken away, the thill is more liable to lift up and communicate with the lower seam than in the whole coal working. This likewise occurs in cases where the original pillars have

not

not been left sufficient to support the incumbent strata; when this is the case, what is called a creep takes place, which is the act of the thill or floor of the mine being lifted up, or the superincumbent strata pressing the pillars into the thill of the mine, which is thrown up, the floor is thus cracked, and communicates with the lower seams; there is, in consequence, an extra discharge of gas from the lower seams.

848. Then, in working the coal mine, a blower may be discovered either from the face of the coal in progress of being wrought from the roof, or from the thill or floor?—In all those cases we meet with them. Besides those that I have mentioned, the coal itself consists of divisions, or a sort of separation, which is termed backs, and which are very frequent in some mines: by a back I mean a sort of division in the coal; in some cases it is simply a division without any other phenomena. In other cases there is a piece of bad coal between the sides of the crack; but those backs generally do not either elevate or depress the coal, they are merely cracks in the coal itself.

849. And those backs also form magazines of gas of larger or smaller extent?—The backs themselves do not form a magazine, but the coal is more easily separated in those places than in the solid coal. In approaching one of those backs the pressure of the gas throws off a portion of the coal adjoining it, and the gas is consequently discharged in much greater quantities than if it was a solid mass of coal.

850. And a greater emission of gas frequently ensues?—Yes; that occurs in some cases to such an extent, as I believe has been termed by Mr. Buddle bags of gas, being thrown out in the coal.

851. What do you understand him to mean by the term bags of gas?—A bag of gas is probably some cavity filled with gas, either in the coal itself, or near to it; and so far as my own experience goes, they are generally found in the vicinity of those backs; I do not mean by bag that it is a large open cavity, but gas highly compressed, throwing out the coal, though Mr. Buddle states some instances in which it has been found in large bags; but I do not know that from my own experience.

852. This you understand to be gas evolved from the coal, confined in spaces of larger or smaller magnitude, according to the nature of such backs?—I do.

853. You have been describing the effect of a thrust which breaks the thill, causing a sudden outburst of gas collected below, where the thill was composed of shale; in your judgment is it more dangerous to work a mine where the thill is of shale, and liable to those sudden outbursts, than when it is of sandstone, and the gas is perpetually filtering through?—I think more sudden bursts of gas occur in shale than when it is of sandstone; but I cannot speak at present of any instance that I know where the thill is of so porous a nature as to allow the escape of gas through it.

854. Even when it is of sandstone?—Where the thill is of sandstone the sandstone itself is not of that gritty nature to allow the escape of gas through it.

855. You mentioned that you frequently met with collections of gas in the slip-dikes, which act as gaspipes to convey the gas for considerable distances; as you approach the slip-dike, is there any indication of one being in the neighbourhood, by any disorder of the strata?—In several cases, in approaching a dike, the coal is more tender; but in a great many cases there is no indication whatever till you meet with those dikes.

856. Is it the practice of the miners, where they do observe an indication of that kind, to use extra caution with their lights, for fear of coming upon a slip-dike?—It is always the practice, where any indication is shown that they are likely to come against a slip-dike, for extra precaution to be shown; and I will refer to the mode of doing so afterwards, on the subject of ventilation.

857. Will you have the goodness to state to the Committee what are the different descriptions of gas, according to their chemical definitions, which are met with in working those seams of coal?—The first description of gas I would mention is the carburetted hydrogen, which is the fire-damp of the coal mines.

858. Do you consider that you have already sufficiently explained to the Committee your idea as to how this gas is evolved in the working of the mines?—I think I have.

859. Is there any other sort, in addition to the carburetted hydrogen?—The carbonic acid gas is the next description of gas which is met with.

860. Under what circumstances is carbonic acid gas met with in the mines?—Carbonic acid gas is of much more specific gravity than the carburetted hydrogen,

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and it is found in the floors of mines; its existence is seen in the floor of the mine first. I cannot account for the manner in which it is produced; it is found in old workings more frequently than in any other case. In coal workings it is very seldom found, unless those workings have some connexion with very old workings; and in large wastes, and in old workings, it comes pouring out in very extraordinary quantities, and in some instances in a most unaccountable way; but this gas is not inflammable.

861. Have you ever met with it in such quantities as to impede the working, or injure the miners in their pursuits?—I have; I have met with it in such quantities that the candles would not burn in it; but the miners are not injured by it till a considerable time after the candles are extinguished.

862. Of course the miners withdraw upon their lights being extinguished by the emission of carbonic acid gas?—They are obliged to withdraw till this gas is drawn off, either by ventilation or by some other mode.

863. What other mode?—A fall in the barometer occasions a considerable change in the quantity of this gas discharged; if the barometer rises, the gas then withdraws to the old workings, and does not come out in such quantities.

864. As the pressure of the atmosphere increases or decreases, the emission of gas is more or less copious?—Yes, and the direction of the wind has in some cases an influence upon it, without a fall in the barometer.

865. Is not that gas much heavier than atmospheric air?—It is.

866. Have you ever known any mines so liable to the effusion of carbonic acid gas as to be prejudicial to men working in an inferior light, in the combination that takes place between atmospheric air and that gas?—I think, if a man was to remain in it for any great length of time after the candles are extinguished, it must injure his health; but I have not had any complaints in the ordinary working of collieries infested with this gas. I have the charge of a colliery where considerable quantities of it are discharged occasionally; I have been myself in it when the candles would not burn, and I must say that I should not like to remain in it any length of time after such an occurrence. I do not think that the men could, without injury, remain very long in it, but the men are never obliged to work at those times; in some cases the working is suspended till the candles will burn freely, which they will do even with a considerable quantity of that gas. I think the health of the men is not injured, I would not say at all, but not materially, in working such collieries.

867. You are not aware of their complaining, that although the quantity of foul air of this description is so great as to injure their light, they have continued their workings under circumstances unfavourable to their health?—I have never known an instance of their refusing to go to work where they were desired to go, in such cases the practice being not to enforce the working where it was injurious to them.

868. You never enforce the working in those cases, if any objection is made?—We do not.

869. You state, that the production of carbonic acid gas is affected by a change in the wind, or a rise or fall in the barometer; is the production of carburetted hydrogen in the same way affected?—Yes, more so than the carbonic acid gas, as being of lighter specific gravity. As I stated before, it exists in those pores of the coal in a state of high compression; if the external pressure is removed, the balance is further destroyed, it issues in greater quantities, and we accordingly find a very much greater discharge, by the fall of the barometer.

870. Have you never known the carbonic acid gas emitted in such quantities as to produce an immediate sense of suffocation, or fainting, among the workmen?—No, never; I think that the light being put out a considerable time before it injures the workmen, guards against any danger of that kind.

871. Do you ever find it emitted from the fresh coal, or only when you get to old workings?—I myself know no instance of that gas being emitted from the fresh coal.

872. Has not the effect of an explosion of fire-damp to produce water, to consume the oxygen, and to leave the carbonic acid gas?—The effect of an explosion is to produce gas nearly of that nature; but where I am speaking of at present, and where the mines are most addicted to that sort of gas, there is very little, and in the greatest majority of instances no inflammable air. I would observe, that the gas, after an explosion, is not precisely of the same chemical nature as the carbonic

carbonic acid gas; there is a great quantity of azotic gas in the mine after explosions.

873. But you have not observed it, in point of fact, except in old workings?—Only in old workings.

874. Is it the practice of professional gentlemen, in your situation, to descend old shafts into abandoned mines, and have you ever in those cases met with the carbonic acid gas in such quantities as to prevent the attempt so to descend?—In a great many cases I have; I have been interrupted in the course of working by the quantity of that gas, and also in getting down old shafts from the same cause.

875. In old workings, in which the air-coursing is destroyed, or completely damaged, have you any simple means of expelling the carbonic acid gas to enable you, or the workmen under you, to descend with safety?—The only mode we have of expelling the gas is to carry it off by ventilation, or by mixing the atmospheric air with it.

876. Do you ever meet with sulphuretted hydrogen in the course of mining?—I have met with a gas, which I suppose to be sulphuretted hydrogen, or that gas in combination with carbonic oxide, in the Tyne Main colliery, which is the only case where I have a personal knowledge of the existence of such a gas, though I have heard of men being destroyed with a gas, which I suppose must have been of the same kind; I have not had it analyzed, but I think it is sulphuretted hydrogen mixed with carbonic oxide, from the smell, and from the sides of the old working containing incrustations of sulphur. This gas is of a very peculiar nature, the very reverse of the carbonic acid gas; in this a candle will burn and life is destroyed; I have been in it myself and have felt the effects of it, to a certain extent. It occurred in a situation of a mine where the men could go into it and come out at pleasure; the effect is felt upon the chest, and it ultimately destroys human life, though during the whole of the time, and until after life is extinct, the candle burns very brilliantly.

877. What are the immediate indications of the presence of sulphuretted hydrogen, such as would be observed by practical workmen?—The first indication is a difficulty of breathing, the candle does not exhibit any appearance that would show the existence of it.

878. Would not the lamp or the candle immediately indicate the presence of sulphuretted hydrogen?—I could see no indication in the candle that I had.

879. Under what circumstances would that ignition, which you describe as leading to fatal consequences, take place?—There is no ignition, but it produces suffocation; it affects the chest first, and destroys life by difficulty of breathing, or by spasmodic affections.

880. Will you give the Committee any instance in which human life has been lost through the agency of this gas?—At the colliery that I mentioned, the Tyne Main, I know instances of men being rendered insensible, that is, they dropped down and were dragged out by other men; but I do not know any instance, within my own knowledge, of human life having been destroyed by it. I have heard of a case at Hartley colliery, if I am at liberty to mention that which has not come under my own observation.

881. The Committee will be glad to hear any facts which you apprehend you have received from thoroughly authentic sources?—The case to which I allude I heard from the viewer of Hartley colliery, Mr. Jobling, it was a parallel case to Tyne Main. At Tyne Main it occurred where an old waste had been drowned, and in Hartley it was a similar situation. The men were approaching the waste and boring to ascertain its existence, they met with the water, and the water and this air issuing through this hole suffocated the person that was working, and the other men that went to his assistance found the candle burning close to where he was lying dead, and they had very great difficulty to get the body out of the place until it was properly ventilated; I have no doubt that this case proved fatal from the circumstance of the candle continuing burning, and the man knowing that the other gases showed some indication upon the candle before it was fatal to human life, that he thought that he was quite safe in working so long as the candle burned.

882. This was a case in which the sudden eruption of sulphuretted hydrogen was fatal to human existence, though not indicated by any change in ignition?—It was.

883. Have you observed the appearance of the candle burning in such gas?—I have.

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884. Is there any indication in it of the existence of the gas?—None that I think would operate as a caution to the miner.

885. Is there no indication in the colour of the flame?—There is a greater brilliancy of flame, I think, but not to such an extent as can be considered in any degree an indication of danger.

886. Are there any other instances similar to this that you have mentioned?—I do not recollect any other instances; I believe the instances are very few indeed.

887. The Committee understand you to state, that you are not aware of this gas having been analyzed by any professional chemist?—I am not aware that it has.

888. But the consequences which you have described confirm your impression, in addition to that of the smell, that it is sulphuretted hydrogen?—Yes; the existence of sulphur in that place, and the smell itself, is what leads me to believe that it is sulphuretted hydrogen, but I think a considerable quantity of carbonic acid gas is in combination with it.

889. Is there no combination of hydrogen that could produce that effect?—I think sulphur is one of the parts of it; I would not state what the other is; I think hydrogen and carbon is the other, and perhaps I may have been led to that supposition, by having read that sulphuretted hydrogen, in certain combinations with other gases, does extinguish life, and yet not put out lights.

890. Do you think that it would be an instantaneous destruction of life, or would not the man be aware of some circumstance which would lead him to escape, if he could?—The first effect that arises is a sort of spasm in the throat, a sort of catching of the breath, that is the first effect that you feel; then you feel a pressure on the chest, which increases, and the difficulty of breathing, and which would be a sufficient indication for him to retire.

891. Do you think the effects would be so sudden as to deprive the person of the power of leaving the place in which he happened to be?—I think wherever this gas exists it is not dangerous. I think a man, with sufficient precaution, feeling the difficulty of breathing, may withdraw from it before he is destroyed.

892. Do you think, in the case to which you are referring, under the symptoms which are exhibited, the man would not have endeavoured to make his escape?—In that case it was a very peculiar one, it was tapping an old waste, where the gas came off very quickly, and I have no doubt that the man would be destroyed before he had any opportunity of reflecting on his situation, as regarded the effect of that gas.

893. You stated that in boring the old waste, the water and gas escaped together?—I did.

894. You have explained to the Committee the way in which the gas is extricated from the coal; you have described what the various gases are which endanger human existence, and impede mining; will you give the Committee an idea of the means which have been most successfully used by yourself, or other eminent viewers, to dislodge those gases from the coal mines in the north of England?—I should state, generally, that the only means we have is by carrying off these gases mechanically by a current of atmospheric air, and that current of air is produced in almost every instance by the operation of a furnace.

895. Do you produce a drawing of a furnace, such as is ordinarily in use in the mines in the north of England?—I do.

[*The Witness produced the same, which was inspected by the Committee*; Plan No. I.]

896. Will you explain the uses and advantages of the furnace so used?—The use of a furnace is to heat the air passing over it, and by its rarefaction to produce a current in the mine; the furnace is placed near the bottom of one of the shafts, or the division of a shaft. Perhaps I should first mention, that in some cases there are two distinct pits to a colliery, in one of which the air descends, and in the other it ascends. In other instances there is only one pit, which is divided by a partition, or what is termed bratice.

897. In the case of a bratice pit, one side of the bratice forming the downward current of air, and the other the upward current of air?—Yes.

898. And the bratice is a wooden partition carried to the bottom of the shaft?—It is a wooden partition carried from the top to the bottom of the shaft, and is always made double.

899. Will you give the Committee an idea of the size, in square feet, of a furnace, such as you would think necessary for a mine of considerable extent?—I would

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I would observe, the size of a furnace depends very much upon the extent of the mine to be ventilated; the ordinary furnace is about six to eight feet wide, and about the same length. Where the mines are extensive, and require a larger furnace than that, two furnaces are placed at the bottom of the shaft.

900. Are those constantly supplied with fuel throughout the 24 hours?—They are, and men are kept constantly to attend upon them to feed them, so as to keep up as equable a heat, and as great a current of air as possible.

901. Have you ever known any instance in which an air-pump has been used as an auxiliary in extracting foul air, or in forcing a current of fresh air?—I have seen it in use, but have never used one myself. I have made some calculation of the power of the furnace in ventilating mines, and the principle on which it acts.

[*The Witness delivered in the Paper, which was read as follows:*]

CALCULATION of the Power of the Furnace in Coal Mines to produce Ventilation.

Let A B represent the shaft or pit which the air is to descend, or what is called the down-cast shaft; C D, the shaft up which the air is to ascend, or the up-cast shaft; and F, a furnace placed near the bottom of the shaft C D.

The effect of the furnace is to heat the air passing over it, which, ascending the shaft C D, forms a column of air of much less density than the air in the shaft A B. It is the difference between the densities of the two columns of air, A B and C D, that produces a continual current of air down the former, and up the latter shaft; and this current of air is increased or diminished as the difference between the density of the one and the other is increased or diminished.

The length of the column, or depths of the shafts, has likewise a considerable effect in producing a greater or less velocity of the current. Let D E = the increase of height of the column of air C D, by the rarefaction of the furnace; then the velocity produced by such rarefaction will be equal to that which a heavy body would acquire in falling through the space E D. Now, the increase of the height D E will be proportional to the length of the column of heated air, C D; hence deep shafts afford more powerful means of ventilation than shafts of less depth. The length of column D E is, as before stated, in direct proportion to the depth of the shaft, but the velocities acquired by falling bodies are as the square roots of the height; the ratio of effect of deep shafts in producing ventilation is, therefore, as the square roots of their depths.

Having, therefore, the depth of the shaft, and the degree of temperature of the two shafts, we can calculate the effect of such rarefaction in producing a current of air in the mine.

Let B = the height of the column of air in the shaft A B.
t = the temperature of air in ditto.
t' = - - ditto - - in shaft C D.

Then $B \frac{450 + t'}{450 + t}$ = C E, height of column of air in the shaft C D, whence C E — C D = D E.

See Tredgold on Warming and Ventilating Buildings, Art. 220.

The velocity which a heavy body acquires in falling, one foot in eight feet per second, nearly.

Therefore, $8\sqrt{D\,E}$ = the velocity of current produced by the rarefaction of the temperature t'.

Or, let h = the height of the column or depth of the two shafts, supposing them both of equal depths.

Then the velocity v produced by the excess of temperature $t' - t$ in the two shafts will be,

$$v = 8\,\frac{\sqrt{h}\,(t' - t)}{450 + t}$$

Taking a furnace, or furnaces, placed at the bottom of a shaft, to keep up an increased temperature of 30°.

Say, t = 60°.
t' = 90.
And h = 300 feet.

$$\text{We have } v = \frac{\sqrt{h}\,(t' - t)}{450 + t} = 33.36 \text{ feet per second.}$$

The velocity which would be produced by that degree of temperature being continually kept up, and supposing the air free from impurities of greater density than the heated air. The smoke of the furnace will diminish this velocity by its greater density, supposed about one-twentieth part; leaving a *power* of furnace, under those circumstances, capable of producing a current of air down and up the shafts, A B and C D, equal to about 30 feet in a second.

When it is attempted to divert the current from its direct passage up the shaft into the mine, for the purposes of ventilation, every change of direction, and the almost innumerable obstructions to which it is necessarily subjected in its passage through all the avenues of the workings, waste and furnace, reduces this velocity very considerably; and, accordingly, in practice, we find that in extensive mines a current of air of little more than three feet per second can be calculated upon.

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My object in making this calculation is to show the power of the furnace, by which some comparison can be made between it and the power of an air-pump.

902. Did you ever compare the difference in ventilation where the furnace was placed at the top and at the bottom of the pit?—I have.

903. Did that confirm the result of your calculation?—Yes, I think it did; all my experience goes to prove that the deeper the shaft, and the longer the column, the greater power of ventilation is acquired; and I have known instances of furnaces being placed at the top of the shaft, and the column above the surface having to be increased in height to produce a better ventilation.

904. Do you make any allowance for the friction in your calculation?—No; I calculate the power of the furnace first, and then make allowance for all the various resistances.

905. Do you think that a common engine stack acts in the same degree, in the ratio, to the square root of the height?—Yes, I think it does, except it is contracted.

906. Supposing it is of the same size?—Yes, I think it does in that case.

907. Is that opinion formed from experiment?—It is formed from observation and experiment, and I would refer to Mr. Tredgold on Steam Engines, who uses a similar formula for calculating the effect of steam-engine chimnies.

908. Have you ascertained the correctness of that formula from actual experiment as to the velocity of the air passing through mines of different depths of shaft?—It is very difficult to make such an experiment, because in that case you would lay the whole of the workings of the pit stagnant; but I made an experiment upon the pressure on the two sides of a partition in the shaft, and that pressure, as indicated by a barometer, corroborated the calculations I have now shown.

909. You state that three feet a second is the greatest velocity with which the air circulates through the mine?—I would not say the greatest velocity. I made an experiment a very short time ago in the Springwell Colliery, where there are two separate currents from the down-cast shaft, one of which travelled more quickly than three feet in a second through a sectional area of 48 square feet, but three feet is what we call a very good current.

910. It has been suggested, that if there is a current of air passing at the rate of 300 feet a minute, it would drive the flame through the meshes of the safety-lamp; are you aware that there are any currents of air passing at that velocity through the mines?—Not where the mine is in an inflammable state.

911. Do you think that the barometrical pressure upon the sides of the partition is a sufficient test of the velocity; may it not show the difference of density without showing the velocity of the current?—It was an experiment on the difference of pressure or density.

912. Does not the difference of pressure show rather a difference of density than a difference of velocity?—It does; but as a confirmation of this experiment, a calculation according to the difference of density in the two sides of the partition, ought to produce the current which the degree of heat calculated by the formula did.

913. Would not that heat produce a difference of expansion of air rather than a velocity of that expanded air?—I ascertained the heat of the air in the air-shaft; that heat ought to produce a certain degree of rarefaction, which degree of rarefaction produced unequal weights of air in the two shafts. The barometer indicated, so far as I could observe, the exact difference which the densities ought to have been.

914. Would not that show the buoyancy of the expanded air rather than the velocity?—It certainly did.

915. Then the difference of the barometer would not be a confirmation of your experiment?—Only so far as showing the difference of density, which was such as the degree of temperature should have produced.

916. Did you ever know a system of fanners, upon the principle of the common winnowing system, only upon a larger scale, used for ventilating the mine?—No, I have not.

917. Will you have the goodness to state the result of your experience or practice with the air-pump in ventilating mines?—I do know from my own experience the velocity of the current that has been produced by an air-pump. If I made any statement, it would be a matter of opinion.

918. Have you ever seen a large air-pump, upon this scale, at work for this purpose?—I have.

919. Where?—At Heaton colliery, and at Hebburn collieries.

920. Have you taken the size of the cylinders or the powers?—No, I have not

921. Are you acquainted with the powers, or with the reputed powers of these machines?—I have only heard by report of the current of air produced by those machines; but I believe a witness, who will be examined by this Committee, knows from his own experience the quantity of current that they produce.

922. You consider ventilation as a point of the first importance in the protection of the miner?—Of the very greatest importance; to produce a good current is of the very greatest importance.

923. Of greater importance than any improvement upon lamps could be?—I should not, perhaps, go so far as that; it is of infinite importance for the perfect ventilation of the mine to have a good current in it; the ventilation is, in fact, a current carrying off the impurities and bad air.

924. Do you think the area of the up-cast pit, as compared with the down-cast pit, has anything to do with the ventilation?—I think the area of the up-cast pit ought to be larger than that of the down-cast pit.

925. Have you ever tried the experiment of an enlargement of the exterior opening of the up-cast pit, what effect that would produce upon the current?—No, I have not.

926. You are aware, that in the case of the discharge of water it has a considerable effect?—It has; but I should not think in air that it would have much effect.

927. Do not you think that the same principle would govern both?—I am afraid not; the principle on which the water acts in that case is by its increased weight; now, the pressure created by any enlargement of the shaft in that case would be very insignificant indeed.

928. Do you think the pressure of the air upon the down-cast pit, as compared with the pressure on the up-cast pit, where the current is made by the rarefaction of the air, has anything to do with the producing of the current?—I should think it has not, except in a mechanical way, by resisting the velocity of the current.

929. Supposing it were possible to remove the pressure of the current from the up-cast pit, and the pressure still continued upon the down-cast pit, do you consider that that would make a considerable current upon the mine?—Certainly it would.

930. Equal or greater than the present current produced by the draught of the furnace?—To have any effect upon that, it should be a vacuum that could be kept up at a greater velocity than the velocity that the air is issuing out of the furnace or up-cast shaft; if my calculations are correct, an air-pump with a piston moving 30 feet in a second, would be required of the area of the shaft, to keep up the same velocity of current as a powerful furnace.

931. Do you think that the effect of the rarefaction of the air passing through the furnace is equal to 14 or 15 pounds an inch?—No; the difference of density is very little.

932. But you are aware that the pressure of atmosphere upon the down-cast pit is equal to 14 pounds an inch?—Yes.

933. If the pressure were removed from the up-cast pit, would not the pressure of the atmosphere in the down-cast pit, being equal to 14 pounds an inch, cause a current through the mine?—It would have a great effect in producing a stronger current, but then I feel that there is great difficulty, in fact an insuperable difficulty, in carrying that into effect, because you must have a vacuum moving at the rate of velocity at which the air issues from the shaft, to produce any effect at all, and to produce an effect equal to the furnace, must move considerably quicker; and I believe the velocity at which pistons generally move is not more than 200 feet in a minute.

934. Which you have described as about three feet in the second?—Yes; but the power of a furnace is considerably greater; nearly 10 times as much as that; but then there is the compression of the air, which reduces the velocity to three feet in a second. The air has to go several miles round about the workings. It is well known, that through small tubes you cannot force air to any great distance: I believe there was an experiment made at the Carron Iron-works, by endeavouring to force air through pipes between one of the furnaces and the other, and the effect was, that although a very considerable air-pump was employed, the resistance of the air was such as to counteract that, and very little current came out of the pipes.

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935. Do you think that the reverse of the experiment would be good, that if you abstract air from the other end of the pipe there would be any difficulty in the air supplying its place through the whole current?—I should think that it would act according to the same laws as by pressure.

936. Supposing a pump were to proceed till it caused a vacuum at one end, do you not think that the air would follow from other parts of the column, so as to produce an equilibrium of pressure through the whole pipes?—I think it would follow, but I think that the spring of the air would have so great an effect upon it that it would flow with a small velocity; the velocity would indeed be in proportion to the size of the pipes, and to the obstacles that it met with.

937. Can you contemplate a case of this kind, a pipe of six feet in diameter and five miles in length, and at one end a perfect vacuum?—I think, in that case, the air would move with considerable velocity, but that that velocity would be considerably diminished by the spring of the air.

938. Do you think that the friction of the air through a given tube is increased as the density increases or diminishes, according to its density?—I should think in some proportion, but I would not state in what proportion.

939. If that were the case, would not the consequence be, that at the vacuum there would be much less density and much less friction, so as to enable it to supply the air which had been extracted?—I think the friction would be less, certainly, but I could not state any specific amount of velocity that it would be.

940. The velocity of the steam-engine piston, being about 200 feet a minute?—I should say that a tube six feet area, five miles long, with a piston travelling at 200 feet a minute, would not produce a current anything like what a furnace does.

941. At the end farthest from the entrance of the air?—Yes; I think that it would have to be a much greater area indeed; and I am borne out in that by the effect of air travelling in the mines as checking the velocity at the up-cast shaft.

942. In the case which you have tried, was it tried with a furnace or without a furnace?—With a furnace.

943. Do not you think that the effect is very much diminished by that circumstance; would not the effect be, that an engine would be working the rarefied air?—The experiment that I mentioned was a barometrical observation.

944. You spoke of a pump once working; in that case was a furnace used?—There was not.

945. Having obtained by any of these means a sufficient supply of air, have you any difficulty in distributing it throughout the workings of the mine?—I would observe, in addition to that sketch of the furnace, which I have produced (No. I.), I can show a mode of working the furnace at the shaft.

(*The Witness produced the drawing*, No. II.)

946. Does your experience enable you to state, whether there is less or more difficulty in ventilating mines which are nearest the surface or furthest from it?—My experience goes to prove, from observation, the deeper the shaft is, the more powerful the ventilation is.

947. In regard to the difficulty of ventilation, do you consider it more difficult to ventilate a mine near the surface than one very much deeper, taking the ventilation in the large sense; do you consider that there is more difficulty in ventilating a mine of 50 fathoms from the surface, or one of 100 fathoms from the surface?—I think there is less difficulty in producing a current of air in a shaft of 100 than in one of 50; and having produced a current, there is no more difficulty in the distribution of it through the workings.

948. Then the consequence of your answer would be, that all mines which are deep are more easily ventilated than those near the surface?—Yes; but deep mines generally producing more gas, are more dangerous.

949. Will you explain the drawing which you have relative to the use of the furnace; will you give a verbal description of the drawing?—It shows a section of a shaft, with a bratice down it; the position, with respect to that shaft, in which the furnace is placed; and it shows also another drift coming into the shaft at a higher level.

950. That is, from another seam of coal, or from the same seam at a different level?—The upper drift is generally in stone. I wish to speak of this as one of the principles of using furnaces in mines, which principle is, that the furnace is placed near the bottom of the shaft; that another drift, in mines producing inflammable gas, is brought in at a higher level up the shaft, the use of which two drifts are, that

that all the air from the whole mine, or air that is not contaminated with inflammable gas, is made to pass over the furnace; and that the air which is contaminated with gas, and which proceeds from the pillars working, or wherever it is liable to become so charged as to be inflammable, is made to pass along the upper drift into the shaft, without coming in contact with the furnace.

951. The distance between those two levels will vary according to the seam and position of the coal?—The difference of those levels varies according to the judgment of the manager.

952. That intermediate drift, has it been excavated for the purpose of winning coal, or for the purpose of communicating to the lower seam?—This upper drift is for the purpose of conveying air into the mine, so that it will not come upon the furnace; it is for that purpose, and not with reference to any seam.

953. How far from the furnace in length is the division which you have described—I will show some plans which will describe the mode in which the current of air is brought to this furnace.

954. Do you find that that current of air going into the shaft has any effect in increasing the velocity?—If the air in the upper drift that passes into the shaft was not inflammable, and passed over the furnace, it would increase the effect.

955. Has the introduction of that air from the upper drift into the middle of the shaft the effect of diminishing the draft of the furnace, on coming into the shaft in that part?—It diminishes it, inasmuch as it fills the shaft more with air; but that does not operate to any great extent, because the shaft is generally of considerable size, and it only operates in expanding the column, and producing a resistance in the shaft; it would produce an increased effect if it could be passed over the furnace; by coming into the shaft without being passed over the furnace, it throws a certain quantity of cooler air into the shaft, which, mixed with this hot air, diminishes to a certain extent, the draft.

956. And it increases the density of the air in such parts of the shaft, and thereby increases the friction?—Yes.

957. Your reason for not taking that air over the furnace is, because it is inflammable?—Yes.

958. What is the object of that?—To keep up the ventilation in dangerous mines by means of the furnace, without risk of explosion; and I would state, as a general principle, that all the air in the coal mine workings, which is not liable to become inflammable, is passed over this furnace; and this drift is for the purpose of taking the air out of the mine that is inflammable.

959. Is such a drift made in all mines which are ventilated by a furnace?—Yes, in all mines where inflammable air occurs to any great extent.

960. Do you know of any case in which the carburetted hydrogen is taken off by such a drift, in sufficient quantities to ignite at the top of the shaft?—I know instances where the air, coming along this drift, would ignite at its entrance into the shaft, but when it comes to be mixed with the other air in the shaft, it becomes diluted; and I cannot say, at present, that I know of any instance where it is inflammable at the top of the pit after being so diluted.

961. Do you know any instance in which it is conveyed from the pits by the upper drift to the mouth of the shaft, and there ignited?—Not of my own knowledge.

962. There would be very little draft, would there not?—There would.

963. Is it an uncommon occurrence for the air to explode at the furnace?—I have not known any instance myself of air exploding at the furnace; I have known the furnace put out to prevent that, previous to the introduction of this mode of carrying the air into the shaft by a separate drift.

964. Where the gas is carried from the mine to the top of the pit in pipes, there it is consumed?—I believe at one colliery it is; and in another instance, under my charge, we pipe the gas from the seam to the top of the shaft.

965. The current, in that case, being caused by the heat in the shaft?—It is entirely distinct: the piping up the shaft, and igniting at the top, is entirely distinct from the ventilation of the mine.

966. In that case the current of gas upwards would be caused by its superior levity and ignition at the top?—Yes, and the pressure of the gas in the pit.

967. Will you proceed with your sketches or drawings, by which you propose to illustrate the ventilation of mines; what is the drawing which you have in your hand?—

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hand?—The drawing, No. III., is a suppositious case of the workings of a coal mine, showing the manner in which it is conducted through the workings.

[*The Witness produced the drawing.*]

968. You have laid down an imaginary coal mine, as simple as possible, with a view of illustrating the mode generally adopted for the ventilating of such a mine?—I have.

969. The darker parts describe those parts of the mine in which the whole of the coal has been removed?—They do.

970. The other intersections are where the coal has been partially wrought, leaving a sufficient quantity of pillars?—They are.

971. The other lines which you are about to describe are the air courses or ventilating courses of such mine?—They are. This drawing shows the two shafts, one the down-cast and the other the up-cast; upon that plan there is also a *staple* marked, which is a shaft to carry the air to the upper-pipe drift above the furnace.

972. That is the drift described in your drawing, No. II.?—It is: the darts shown upon this sketch point out the direction in which the current moves; the dark lines across the openings are stoppings, to keep the current in a proper direction: there are some double lines, which are doors where it is necessary to go through to conduct the workings. I will just describe how it is passed through this imaginary sketch: this is a case of the *ordinary* mode of working a colliery, where the working in the coal mine is carried on in the first instance, leaving pillars which are afterwards to be taken away.

973. The Committee, then, understand, that the plan may be meant to describe the mine in its whole extent?—It is meant to describe a mine commencing to work, the system of which is to work the whole coal first, leaving pillars, which are afterwards to be taken away. I will show a sketch afterwards of a different mode of working.

974. Will you proceed with a description of the air coursing?—In this case the air is taken direct from the down-cast shaft to the extremity of the workings, carried through the whole coal workings of the colliery, and taken over the furnace to the up-cast shaft, as shown in No. II.; that is what we call coursing the air. This is capable of great variety: here the air is taken along the bords, and brought down through the waste and into the working bords again, and so on all the way to the shaft. There are other cases where that mode is not advisable. In some cases it is necessary that the air should be taken along the face of the workings first, and afterwards taken into the waste, and then carried over the furnace. There are other cases where the discharge of gas is such in the bords as that you cannot mix the two together; for, being of different specific gravities, the inflammable air floats at the top, and it requires what is termed "dashing of the air" to mix them: it requires, in such a case, that they should be circulated for some distance before they get so mixed as to render them not inflammable to the candle, and in that case it is necessary to carry the air into the waste to mix it.

975. Are any mechanical or artificial means used for incorporating the two gases?—The mode practised is, by carrying the current backwards and forwards in the mine, and by a constant agitation, it is accomplished. I have another sketch, which will show the mode of carrying the air into the workings, where the men are working, or in the bords.

976. Have you numbered that sketch?—I have; it is No. V.

[*The Witness produced the same.*]

977. You are therefore about to describe the sketch No. V.?—I am. I am now describing the workings in the whole coal. The sketch, No. III. shows the mode of coursing the air generally throughout the workings. This sketch, No. V., shows the manner in which it is ventilated in the bords, or where the men are working: in ordinary cases, where the discharge of gas is not great, it is not necessary to carry the air up close to the men, where they are working in the manner described in No. V.; but where the discharge of gas is considerable, it is necessary to resort to that expedient; and this sketch, No. V., is a portion of the workings, showing that operation, which is performed by a temporary partition or bratice being carried up each bord, and therefore the air, as shown in the darts, is circulated through the workings, being taken up on one side of the partition and down the other. In several cases it is necessary that a door should be placed at what we call the bord end, or at the foot of the bord, to force the air up on one

side

side of the bratice and down the other; and this is the mode of airing the face of the workings as at present practised. After the air is taken up and down the bord, it is then conducted into the waste: but I would observe that these wooden partitions are of a temporary nature; they are to be taken out as soon as a communication is made between two of the bords, and it is quite impossible in practice to carry the whole of the air up them; as much air is carried up as is considered necessary, but by no means the whole quantity.

978. No. V. is a plan of the necessary deviations of the air coursing, in cases where in working the bords, or separate and distinct galleries, a supply of fresh air is absolutely necessary in addition to the ordinary ventilation?—Yes, it is.

979. Are you speaking of the operation of working the pillars?—No; I am speaking of the operation of working the whole coal; I am going to speak of the pillars immediately.

980. Will you proceed with the further sketches which you have?—I will now follow up the description of No. III. by which it is shown that the air from the whole coal working goes over the furnace, as I before observed; I stated the air to be taken to the extremity first, it is there split or divided, one portion of it going through the whole workings, and the other through the workings in the pillars; the direction of the darts will show the manner in which the air is carried through the pillars, but, as a matter of course, when the pillars are taken out, that ventilation is not perfect; the air can be forced up to where the pillars are worked, but there is no means of forcing it back again so as to keep it in its regular course; in that case temporary stoppings are put in as marked (*a*, *a*,) &c. upon the plan, by which the air is taken as near to where the workings are going on as possible, and that air is universally taken along the pipe-drift above the furnace.

981. Have you any further illustrations to give of the mode of working the whole mine, or of taking away the pillars?—[*The Witness produced another drawing.*]—This sketch No. IV. shows workings conducted upon a somewhat different principle, where the plan of working is, to take off the pillars in the same operation as in working the whole mine, or where the two operations are conducted at the same time.

982. In that case you contemplate going to the limits of your boundary before you work coal to any considerable extent?—No, I do not; this shows the operation to have commenced near to the shaft, and it is supposed to be conducted according to this mode of working as you proceed from the shaft.

983. Are there any peculiarities in ventilating a mine worked upon that system?—Where the mine does not produce much gas, it is worked in the same way, in some instances with candles entirely; and where there is any gas produced, liable to render the air inflammable, the working is carried on with lamps, and the air in that case, as in the other mode of working pillars where it is liable to become inflammable, is taken over the pipe-drift and not over the furnace. The direction of the darts will show the current, and in some cases it is necessary to make one current of air cross over the other, and those places upon that sketch are marked C. This system is varied according to the peculiar circumstances of each mine.

984. Do you, as a professional man, attach any importance or relative degree of importance to those different modes of working a mine, in reference to the ventilation and safety of the mine?—Not with regard to the safety of the mine I do not, or ventilation; the Plan No. IV. is to show that the same mode of ventilation is pursued in both cases.

985. And therefore either plan may be pursued with safety to the mine, according to the discretion of the viewer?—Yes.

986. In the case where there would be an upper drift, did you not say it should be 16 yards above the level of the mine; is the drift parallel to the level?—Not necessarily so; the upper drift runs in the same direction as the main drift upon the sketch, and in the same level as the coal seam, unto within a short distance of the shaft, within 20 or 30 yards, or any other distance, and it is not carried on a higher level until near to the shaft.

987. Then the upper drift does not run many yards from the shaft?—Where they separate at the two levels, it is close to the shaft.

988. Where is the inflammable air of the mine brought into the upper drift?—The inflammable air is kept entirely distinct from the air carried over the furnace in the mine by the stoppings; it is then brought near to the shaft, carried up a small pit to the upper drift or tube level, and there taken into the shaft.

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989. The process of ventilation having been accomplished by those various means, what objection do you conceive exists to the use of candles in such a mine?—In working the whole mine it is almost in every case absolutely necessary that candles should be used; in many cases a great majority of the mines produce very little gas, and where the gas produced is not more than can be carried off the workings with safety by the means described, I think candles may be used with perfect safety. Where the discharge is of course so great, either in working the pillars or the whole mine, as that it cannot be carried off without becoming inflammable, lamps should be used.

990. But you are aware of the existence of many mines in which the proportion of carburetted hydrogen is so small that there is nothing to fear as regards an explosive atmosphere?—In the great majority of collieries upon the Tyne I think the ventilation may be carried on without any risk of such accidents occurring.

991. Then the introduction of lamps in preference to candles is a question to be decided by the experience of the viewer?—I think so. I would state that the mode of conducting the air up the bords in the way that I have described, by which a portion only of the whole current can be taken by the bratices up those bords, in some degree averts the risk. The first appearance of danger is in the bords, where the gas is emitted out of the coal, and where the current of air is least; it is consequently most liable to explode there; and when the ventilation is otherwise perfect, the existence of gas is easily detected, and an explosion, if produced, will only extend to a very short distance; therefore, so long as the discharge is not so great as to make it generally inflammable, candles, I think, can be used with perfect safety.

992. Then you mean to say that you should consider a mine might be judiciously wrought by having candles in a large proportion of the mine, but compelling at the same time the workmen in particular bords to use the lamp?—I think so, in mines where considerable discharges of gas exist.

993. Under those circumstances, do not you consider it possible that a man working in any given bord may suddenly come in contact with a blower, and occasion an explosion of the whole, or a considerable portion of the mine?—Where the ventilation is perfect, I think that is not likely to happen, because, as I stated before, the first existence of danger is in the bords; it is apparent there, and if the discharge is not such as to contaminate the whole quantity of the air, the explosion does not extend beyond that point. Immediately that the air comes out of the bord, it then meets with a further quantity of fresh air, and if it passes the candle of the miner in the bord without igniting, it cannot be inflammable when it meets with an accession of fresh air; therefore I would say, that the operation of working in the bords is a sort of test by which the safety of the mine is in some degree secured; and it is only when the discharge becomes so great as to contaminate the whole of the air, or that by some casualty the ventilation is destroyed, that a general explosion could take place.

994. But may not a considerable number of years be consumed in approaching a back in which there may be bags of gas, as already described, so entirely at the same moment met with, as to occasion a dangerous eruption of foul air, sufficient to contaminate a section of the whole mine?—I think a bag of gas may be met with which may contaminate a portion of the mine, and if that is stumbled upon by a workman with a candle, of course it would ignite. I cannot think that any very extensive explosion would take place in such a case, if the ventilation is perfect; but the effects of such explosions sometimes operate to destroy the men, by the stoppings being blown down and the atmospheric air destroyed, and consequently an irrespirable air only left in the mine. We had an instance at Killingworth colliery about a fortnight ago, of a man meeting with a very sudden discharge of gas in the way described. I have brought a sketch of the position of the workings, which will show how that accident occurred, and that the explosion was confined entirely to the place where it occurred. The discharge of gas in that portion of the mine was very considerable; so much so as almost to mix the air so as to render it nearly inflammable throughout that section of the mine, before the whole of the workings were ventilated. The accident happened in a bord which I believe will be nearly described by reference to *a*, on the Plan No. III.; one man was working, and he met with a very sudden discharge of gas, which ignited at his candle, and the man's face and hands were burnt, but it did not proceed any further, because the quantity of air carried into that bord by the bratice was not nearly so much as was going through the other parts of the mine, therefore

therefore immediately the air came out of that bord, it was reduced below the inflammable point, and the explosion did not therefore extend further.

995. You say, that the first intimation you have generally is by the bords; is there no better way of obtaining that intimation than you obtain by that means?—I am speaking of working the whole mine with candles; the test of examining the air with the candle is the most delicate way of ascertaining the existence of inflammable air. The safety-lamp does not exhibit any appearance by which it can be ascertained precisely when the air becomes inflammable; after it is considerably inflammable, it appears; but I would say that the safety-lamp does not indicate the appearance of inflammable air where that air would ignite with the candle.

996. But you obtain information first by means of the bords, when there is inflammable air; is there no better means of obtaining that information than by that accidental manner?—I think not; you cannot ascertain the danger till the air is discharged; the safety-lamp is not a sufficiently delicate test, and there is no other way that I know of ascertaining its existence before it becomes inflammable than with a candle.

997. It does not give you any warning?—It does not, generally.

998. What lamp is in use in the collieries under your view?—I have used different kinds of lamps.

999. What do you consider the best?—I have brought different lamps with me, for the purpose of explaining that to the Committee.

1000. Will you have the goodness to produce the lamps which you have heretofore used, pointing out those which you think ought to have a preference, under the circumstances which have come under your observation?—These are the several lamps, and this is a steel-mill, by which light was originally obtained, prior to the use of the lamps in inflammable mines.

[*The Witness produced several Lamps and a Steel-mill.*]

1001. Have you marked the lamps in any way?—I have not.

1002. Will you have the goodness to put a mark upon each of them, numerically, so that the Committee may understand of which lamp you are speaking in the course of your examination?—I have now numbered them; there are five lamps.

1003. Will you give your description of No. 1, and of the following numbers?—No. 1 is the common Davy-lamp; No. 2 is the common Davy-lamp, with different seams; No. 3 is Dr. Clanny's lamp; No. 4 is the common lamp, with glass; and No. 5 is an improved construction of the lamp with glass.

1004. What do you consider to be the nature of the improvement as regards the seams in No. 2?—The common form is, in my opinion, better than the lamp with different seams.

1005. You consider that the alteration in the seams is not an improvement?—No, not in safety.

1006. Do you consider that they are more or less liable to break?—I think they are not so strong.

1007. Is the mesh of the wire the same in both the lamps?—It is.

1008. What was the assumed benefit of No. 2?—It was made by a different person; it was an idea of his that it was more neat, and I believe some may be of opinion that it is stronger; but I think the old form is quite as strong as the other. There seemed to be an objection to the doubling of the wire in the old form, and No 2 obviates it; but I should not think that the alteration is any great improvement, though I do not say that it is worse in practice than the other.

1009. From your practical experience, you do not perceive any benefit to be derived from the alteration in the mode of seaming?—I think no benefit.

1010. Have you ever known circumstances of the lamps breaking at the seam prior to their being worn out or injured in fair wear and tear in other parts of the seam?—Not within my own knowledge; but I have not the means of knowing that. The lamps are in the care of a person, and they go to him; I have not heard that such a circumstance is of frequent or dangerous occurrence.

1011. As viewer of the mine, is it not his duty to report to you anything relative to the safety, or otherwise, of the lamp?—If any serious defect was discovered in the construction of the lamp, I would say that it was his duty to report to me, or any wilful neglect, injuring lamps; but when the lamps are worn out it is not necessary that he should do so; his duty is to attend to them, and keep them

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in good order; no lamp proceeds from him without his first examining whether it is perfectly right in all the parts of it, and he is accountable for the perfection of the lamps before they are used. The lamps are never sent into the mines unless they are perfectly complete, and inspected by him.

1012. It is understood that the viewer directs the kind of lamp which shall be in use in the mine, or certain parts of the mine, and the man that takes care of the lamp sees that the new ones are perfect, and that the old are kept in perfect repair?—It is so; and no lamp is allowed to be carried into the mine without passing through his hands.

1013. Is that examination daily?—It is.

1014. Does the miner leave his lamp with this man always on leaving his work, and receive the same, or another, on the following morning?—Generally so; in some cases the miners have to clean their own lamps, and have the care of them; and in other cases they are left under-ground: there is, however, always a degree of dampness in some mines, and in some instances it is better that they should be taken out of the mine than left there; but in both instances the lamp is not carried into the workings of the mine without being taken to the man to inspect it.

1015. Are the lamps cleaned by brushing?—Yes.

1016. Has not that a tendency to widen the meshes?—Only mechanically, by wearing away the wire, which would be a long operation.

1017. Are not the transverse filaments liable to slide upon the perpendicular ones?—I have seen wire where the perpendicular wires were nearly strait, and the transverse ones bent over them; in that case the transverse wires were very liable to slide over the other; but in wire properly formed, where the bend is equal in both warp and woof, that liability does not exist.

1018. Do not you apprehend that a very great number of lamps have been made with the gauze of the imperfect construction which you have just described?—I have reason to believe that there have been.

1019. Do not you think that lamps with such gauze are peculiarly dangerous?—I think so.

1020. Is there any difference, so far as your knowledge goes, in the price of lamps with the different descriptions of gauze which you have just described?—I believe there is a difference in the price; and I believe, in that case, the imperfect gauze is of a lower price than that which is properly constructed.

1021. Do you consider any economy in such a matter justifiable on the part of the viewer, or the man who takes care of the lamps?—I think not; and I cannot believe that the use of this wire, if known to the viewer or coal-owner, would be sanctioned.

1022. Do you apprehend that it could escape the observation of a man well acquainted with lamps, and accustomed to the care of them, that the gauze was made on this inferior scale?—I think it might.

1023. Would he not be likely to detect it on the first application of the brush, to remove extraneous particles?—No; I think the wire I saw was not so bad as to cause it to slide with the operation of brushing; I think it would require a greater force to cause it to slide, but even that was most dangerous.

1024. Do not you think that a lamp suddenly coming in contact with a piece of coal might have the meshes so deranged as to endanger explosion, having imperfectly-formed gauze?—I think scarcely; the men generally are not so careless of their lamps as to risk such an accident; it could only be done very negligently or wilfully.

1025. In case of any accident, by carrying a lamp through a bord, might not such an occurrence take place, and not be observed when the lamp came afterwards to be lighted?—It might; such a case might happen.

1026. Might not such a circumstance account for the otherwise unaccountable accidents which have taken place, where those lamps have been in use?—I can account for some of the accidents only in that way, or by carelessness.

1027. Have you ever heard of an instance in which a man fell with his lamp upon a pickaxe and caused an explosion by his sudden rupture of the gauze?—Not within my knowledge.

1028. Have you ever heard of such an instance?—I do not recollect at present.

1029. You have spoken of No. 3, as Dr. Clanny's improved lamp; have you had any opportunity of judging of the merits of that improvement?—Not practically; it is only recently that I heard of it.

1030. What

1030. What is your opinion of its value, as a practical viewer?—When the Davy lamp is put into an inflammable mixture, it of course becomes red hot, if the mixture of inflammable air is very considerable; if it is kept in such a mixture for a length of time, of course the heat will destroy the lamp, and it will ultimately become unsafe. The practice in such cases is, that the men should not keep a lamp in such a state; they have orders that whenever a lamp becomes filled with flame in the inside, they should withdraw it. Dr. Clanny's lamp, by the brass-wire being burnt away, will of course prevent the lamp from being kept in such a mixture, and so far as regards the use of the Davy-lamp, where it is liable to be filled in the inside with flame, I think it is useful. But I would say, that that is in extremely limited cases, and probably such cases should not exist generally. I think the mines ought not to be worked where they can only be worked with a lamp filled with flame.

1031. Is there any drawback from that benefit in Dr. Clanny's lamp?—I have not had an opportunity in practice to see its operation; but the only objection I see to it, as a matter of opinion, is, that the shield will throw a greater quantity of heat to the upper portion of the wire, and render it more liable to be burnt; to what extent that will operate, or whether that may not be remedied by a different construction, or that it may not exist to such an extent as to render it objectionable in practice, I cannot give a decided opinion. With these exceptions, and the liability of the slides to get out of order, I think Dr. Clanny's invention useful in the cases that I have mentioned.

1032. You have stated that such cases ought not to occur as men continuing their lamps in a decidedly explosive atmosphere; cannot you conceive a case of a man just on the point of bringing down his coal being tempted to allow the lamp to remain a few minutes, or in the case of his having nearly filled his basket or corf, most imprudently continuing his lamp in that dangerous situation?—I believe that such cases may occur in a mine that is highly charged with gas, where the common lamp may become filled with flame, and yet may be used with safety; still cases may occur that may cause the fire-damp to come into that mine in such quantities that it may be filled with flame for a considerable time, and where such cases do occur Dr. Clanny's lamp may be useful.

1033. At the same time you admit that it would be in the power of the workman to prop up the shields?—I think it is.

1034. If he was so wilfully disposed?—Yes.

1035. Do not you think that such a lamp is of great benefit to the wasteman, in his morning examinations of the state of the mine, or in exploring abandoned parts of the mine?—I think in exploring the mine in the morning such a lamp is not so useful, on this account, that the people that have charge of that operation are generally men who are selected for their caution, and those men would not use the common lamp in such a case improperly; they would not carry it to such an extent as to let it be filled with flame, and continue for that length of time which would injure it.

1036. Do you agree in the statement that great risk may arise from a person carrying the original Davy-lamp at a quick pace through an inflammable atmosphere?—So far as my own experience goes, I do not know that carrying it at a considerable velocity would cause the flame to pass through the wires. Sir Humphrey Davy's experiments go to state that such is the fact. I have never seen lamps carried, even in mines where there is no great risk, with that velocity which would cause it to pass through, if such a case is possible, and I cannot conceive that any man in a mine, where it was dangerous, would put a lamp to such a test, unless it was done wilfully.

1037. You heard the evidence of a former witness, Elliott; do not you agree with him that there was an advantage in his having so immediate a proof of the explosion of the atmosphere in which he was working?—There I would state, that not having had it in an inflammable mixture myself I do not know exactly how it operates; but that witness stated he did not see the lamp on fire before the wire was burnt in two. I do not know whether it was a fact that the flame was or was not visible before such a thing took place. If the flame was visible before it took place, the existence of the flame in the common lamp would have caused him to withdraw in some way as the shield did; but if it was invisible, then I should say that Dr. Clanny's lamp was useful.

1038. Are you not bound to suppose a case of the judicious wasteman, not at the moment apprehending the explosiveness of the atmosphere in which he was working,

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working, being thus suddenly reminded of what he had not before apprehended?—I think such a case may exist, if the flame is not visible before the wire is burnt in two. I would say that I think it important to know whether the common Davy-lamp, by the elongation of the flame, shows the existence of inflammable air before the wire is burnt in two in Dr. Clanny's lamp, of which I have not had an opportunity of experimenting. In the hands of a careful workman, if the elongation of the flame precedes the burning of the wire, that workman should depend upon the appearance of the flame rather than upon Dr. Clanny's lamp as showing the existence of inflammable air; but in the hands of the majority of workmen not so careful Dr. Clanny's lamp may be useful.

1039. But the most careful workman at his work may not be observing his lamp?—Yes.

1040. And the shields become a watch for him in that case?—Yes.

1041. To Dr. *Clanny.*]—In your lamp, the effect of the shield dropping is to exclude the inflammable air, but not to affect the oil lamp light?—Precisely.

1042. Is the oil lamp then extinguished?—It is not, and for the reasons I will give; when the inflammable air is in communication with the flame of the oil lamp, a blue flame plays within the wire-gauze cage, this blue flame immediately fuses the piece of wire passed through the cage, and at that moment the safety shields fall by their own weight; a small perforation is made at the bottom of the outer or lower shield on each side, through which a sufficient quantity of atmospheric air containing inflammable air at the inflammable point, penetrates and maintains the flame of the oil lamp only.

1043. You have heard the opinion of Mr. Wood, that there may be an increased heat in the upper part of the lamp, in consequence of its being covered with those shields, and in that way endanger the wire; what is your answer to that?—I am much obliged to the Honourable Chairman for putting that question, for I am sure that Mr. Wood, the witness, will be satisfied upon that point when he observes that the upper shield leaves the wire-gauze, to the extent of three quarters of an inch above the said safety shields, which will keep the cylinder cool enough, and in the course of my experience I never found any additional heat in using this lamp.

1044. Have you any further observation to make upon this point?—Nothing further.

1045. To Mr. *Wood.*]—Have you any further observation to make on Dr. Clanny's improvement?—I would observe, that the objection which I have stated against Dr. Clanny's lamp is not with any intention of detracting from the merit of that lamp, because I think it is well worthy the attention of the coal-owners; I only made those objections because I think that in all those cases the utmost caution should be used before a decisive opinion, in such dangerous circumstances, is expressed upon any plan.

1046. You stated that your objection was matter of opinion, and not founded upon any experiment?—It is; I think it well worthy of further inquiry and attention.

1047. No. 4 the Committee understand to be a Davy-lamp, with a glass chamber?—It is.

1048. Will you describe what you conceive to be the advantages from the introduction of the glass chamber?—As I have stated before, the Davy-lamp becomes filled with flame from the construction admitting the air to pass into the lamp, over the whole surface of the gauze; the glass chamber is for the purpose of diminishing the quantity of air which passes into the interior of the lamp.

1049. Is the glass ground at the bottom, so as to fit closely on the upper part of the lamp?—There are two constructions of lamp which I have; No. 4 I have used at Killingworth and at Springwell colliery for a considerable time.

1050. Is there anything besides the glass chamber peculiar to No. 4?—No. 4 is the common construction of that lamp; the construction of that lamp is objectionable in some respects, because the man may open the lamp even though a lock is put upon it. No. 5 is an improvement upon that construction, by which the lamp may be completely locked, in the same way as the Davy-lamp, and prevent the man from taking the top off.

1051. Is not the structure of this improved Davy-lamp rather reverting to Mr. Stephenson's original lamp of 1815, which was insulating the flame by a glass chamber, and communicating with the external air by small orifices?—I should say

say that the lamps, Nos. 4 and 5, with the glass which we are describing, without the gauze, is of the principle of Mr. Stephenson's lamp of 1815.

1052. Then you consider the glass tube particularly advantageous in cases where anything should occur to destroy the gauze?—I should say that the part of the lamp which I have most dependence upon, as regards safety, is the wire-gauze, inasmuch as the glass is liable to be broken; I think the glass extremely useful in contracting the current of the air, and keeping the wire always in a perfect state.

1053. Do you mean to say, that practical observation satisfies you, that with that glass, and the flame in an insulated state, there is no more combustible air admitted through the small aperture at the bottom, than is necessary to feed the lamp?—Not more; it contracts the quantity of air admitted into the interior of the lamp, and that is extremely useful in many instances, I believe that this lamp is put out before the Davy becomes red hot; that it is put out by an atmosphere which would not heat the Davy-lamp red hot; and that it will not burn in an atmosphere where the Davy-lamp would become red hot. In some degree it operates, as it were, in the same way as Dr. Clanny's lamp, showing the existence of the mine in a very inflammable state.

1054. That is to say, that the limited quantity of gas of any description which is admitted, operates, in the case of very foul air, as an extinguisher to the lamp?—It does; and I have tried the two lamps together; the lamp with glass was generally put out before the Davy-lamp became filled with flame. I must again revert as to Dr. Clanny's lamp, whether this lamp, No. 5, would not, in some degree, be as useful in showing the existence of air of a certain degree of inflammability in the same way as Dr. Clanny's lamp does; as I stated before, I have not the means of judging which of the two would show it first, but I think it extremely important that some lamp, either the one or the other, could be used for such a purpose; on the other hand, on going into an inflammable mixture, which is merely inflammable, or just upon the point of inflammability, the Davy-lamp shows the existence of inflammable gas sooner than this lamp with glass; it is more apparent to observers.

1055. Then under all the circumstances of the case, not having experimented upon Dr. Clanny's lamp, you consider No. 5 to be decidedly the nearest to perfection of any lamp which you have hitherto had an opportunity of examining?—Yes, as being put out when the air in the mine is in the highest state of inflammability.

1056. And on that account the safest lamp in highly inflammable mines?—I do not know whether it is absolutely safe or not; I have paid considerable attention to those things, and I find in chemists so great a difference of opinion upon the point, that I am in some doubt myself whether it is nearest perfection or not; on this account, I shall take an extract from Sir Humphrey Davy's work, and from another work on the same subject. Sir Humphrey Davy's opinion, as shown in that extract, would go to state that No. 5 is not safe, Sir Humphrey Davy says in his work on safety-lamps——

1057. What work are you about to quote?—It is a work "on the Safety-lamp for Coal Mines, by Sir Humphrey Davy," published in 1818, by Hunter, of St. Paul's Church-yard; he states in p. 19, that "if mixtures of fire-damp are burnt from systems of tubes or canals, or metallic plates, which have small radiating and cooling surfaces; though these systems are safe at first, they become dangerous as they are heated;" and in a note, he says, "I warn the coal miner against any pretended safety-lamps made in this manner, and which to superficial observers may appear to be constructed upon principles of security, but in which those principles cannot really exist." That is one portion of his work; Sir Humphrey Davy's theory of the principle of safety of his safety-lamp, is the wire acting as a radiating power, and also as a conductive power, and inasmuch as a flat plate perforated with holes, there is not the same radiating surface, therefore a lamp so constructed is not safe, according to Sir Humphrey Davy; therefore the safety of the lamp depends upon the radiating power in the wire-gauze.

1058. You are of opinion that Sir Humphrey Davy's theory must be regulated by the extent to which he carries that theory, and the degree of radiation requisite?—I am not competent to judge whether it is a correct theory or not; but I stated that it throws a doubt upon the minds of practical men, whether perforated plates are safe or not, I have no doubt of the safety myself; but it is important that it should be ascertained in a practical way, because another person writing upon the

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safety lamp, speaks of the very reverse being the fact; and I think in a very dangerous sort of way.

1059. What are you about to quote?—From a work by Mr. Murray, intituled "Practical Observations on the Phenomena of Flame and Safety-lamps," published in 1833, in which he states in p. 10, "It seems, therefore, evident, that the principle of safety cannot depend upon any cooling influence whatever, whether it be connected with contact or radiation." Now according to Murray, this lamp, No. 5, would be perfectly safe, though Sir Humphrey Davy gives a different opinion; he goes on to state, "accordingly, it is found that when the safety-lamp is newly lighted, and it is consequently more cool than at other times, it is very apt to explode the air of the mine, and will kindle a stream of hydro-carbonate; under such circumstances, even when six folds of wire-gauze interpose, while it will not permeate one such fold if the lamp be hot;" that is I think the very reverse of the fact of my experience, and it certainly is a very dangerous sort of opinion to be given by a chemist, who I believe is very high in his profession, and coming into the hands of practical men. My reason for giving these extracts, is to show that Sir Humphrey Davy's observations throw some doubt, in my mind, as to the safety of this lamp, though in practice I have tried it in every situation in a mine in which a lamp could possibly be taken, where the transition from good air to inflammable was sudden, and which I believe is the severest test that a lamp could be put to, and I found it never exploded externally; therefore, so far as practical experience goes, I have found it quite safe.

1060. Have you continued it for any length of time in an explosive atmosphere?—I have continued it till it went out, and in every case, as I stated, it went out before the mixture became of a certain degree of inflammability. I would add further with respect to this lamp, that if metallic plates perforated with folds be perfectly safe, I would consider this lamp as doing away with another objection made against Sir Humphrey Davy's lamp, which is that of the flame being carried through the wire by a considerable current, which Dr. Clanny's lamp is also liable to.

1061. (To Dr. *Clanny.*)—Have you experimented upon the effects upon your lamp in the case of its being rapidly carried through the air?—I have, and it goes out instantly, before there is time for the flame to pass outwardly through the wire-gauze, were there perforations in the gauze.

1062. (To Mr. *Wood.*)—Have you any caution to suggest in the use of your improved lamp?—The air being conducted from the bottom, and passing only through the top of the lamp, throws of course all the heat to that point; and we find in practice it requires considerable care in seeing that the wire is not burnt through in the upper portion of the lamp; and that rather led me to make the observation about Dr. Clanny's, where the heat is directed to one point; I consider the glass lamp more liable to this than Dr. Clanny's lamp.

1063. Would not that be remedied by having a false top or cap in addition to the one placed at the ordinary distance?—There are in this lamp three tiers of tops, the copper top, and the common top belonging to the wire, and a loose top likewise.

1064. Supposing all lamps to be so constructed, do not you apprehend the danger you have spoken of would be effectually guarded against under a daily examination?—I cannot go to such a length as that. There is another property belonging to this lamp, which is considerably obviated in this improved one; but I have not had much experience with the lamp in this state; No. 4 is of considerable size, and in cases where the glass is broken, and the gauze then becomes the only safety; I believe the large cylinder is much more dangerous than the small one. I think Sir Humphrey Davy goes to prove that cylinders above a certain size pass the explosions, and in the lamp No. 4, it is considerably larger than that size which he recommends; this large diameter was made with a view of the glass being liable to be so heated as to crack; if the glasses are properly tempered, such a heat as that produced within it should not have any very great effect upon it; and it appeared to me that there was no reason why the diameter of the glass could not be reduced, and that was one reason for my making this lamp of a smaller diameter; but still it cannot be made of so small a diameter as that standard which Sir Humphrey Davy states it would be dangerous to go beyond. That is one objection which lamps with glass in the inside necessarily have.

1065. You say that you have tried your lamps in an atmosphere of carburetted hydrogen, that compelled the extinction of the lamp; is there any contrivance by which you could see your way out?—None at all.

1066. Have

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1066. Have you made any experiment with the lamp suggested by Sir Humphrey Davy, which had a piece of platina wire ignited at the top, and gave out some lustre after the lamp had been extinguished?—I have tried it in a mine, as an experiment only.

1067. Do you think it could be made an available improvement?—I think it would be required in so few cases, that it would not be practically necessary to adopt such an expedient; it is only to enable a person to get out of the place where he is working when the lamp goes out; but a workman can walk out very easily without a light, and there is no necessity for such an addition to the lamp for that purpose.

Jovis, 25° die Junii, 1835.

JOSEPH PEASE, ESQUIRE, IN THE CHAIR.

Mr. *Nicholas Wood,* called in; and further Examined.

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1068. HAVE you ever made any experiments as to the relative proportions of light carburetted hydrogen gas and atmospheric air, which form the most explosive mixture?—Yes, I have.

1069. Will you state in numerical proportion the relative quantities of atmospheric air and light carburetted hydrogen gas which form the most dangerous mixture?—I believe a proportion of eight parts of common air and one part of carburetted hydrogen form the most explosive mixture; it becomes explosive when the proportion is 13 to 1, and increases in inflammability till it becomes the proportion of eight to one, then I believe it diminishes in inflammability as the proportion of carburetted hydrogen increases, until it comes to a proportion of three or four to one, when the quantity of atmospheric air is then insufficient to support combustion.

1070. Have you ever tried what the results are in exposing bodies, of iron for instance, in a red heat to those combinations of atmospheric air and carburetted hydrogen?—No, I have not exposed iron red hot to explosive mixtures. I have made the experiment with a candle and with a lamp.

1071. Are you prepared to state whether the gauze of a lamp heated to redness will cause ignition in the surrounding gas?—Not from my experience in mining, though I have seen them red hot without passing the explosion. I only know it from reading the experiments of Sir Humphrey Davy.

1072. What is your conviction from reading those experiments?—The conviction on my mind after reading those experiments is, that so long as the heat is such that the lamp is only at a dull red heat, it will not explode through the meshes of the wire; if it is increased in intensity of heat so as to nearly fuse the wire, then it would pass the flame, and it would explode in the mine.

1073. Was not Sir Humphrey Davy's opinion that even white heat would not cause explosion?—I think Sir Humphrey Davy's opinion is that white heat will cause explosion with a certain current. I could refer to the part of it, if it is material.

1074. Will you have the goodness to refer?—Here is a passage which refers to the subject, wherein Sir Humphrey Davy states, "that single wire-gauze of the kind used in the common miner's lamp is impermeable to the flame of all currents of fire-damp, as long as it is not heated above redness; but if the wire be made to burn to a strong welding heat, of course it can be no longer safe; and though such a circumstance can perhaps never happen in a colliery, yet it ought to be guarded against." Then he goes on to instance an experiment made at Lambton colliery upon a blower of gas, where with a certain velocity of current, and a degree of heat on the inside, the explosion was passed through the wires of the lamp. That is in illustration of the opinion he expresses.

1075. From what page have you quoted?—It is in page 136 of the same work that I quoted yesterday, and the experiment is in 137 and 138.

1076. Supposing Sir Humphrey Davy's theory and experiment to be correct, can you suppose the gas burning in a lamp so as to produce a white or a welding heat?—I think not. I think the gas in the mines is never in that state as to produce

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duce such a heat. I do not know that such a heat could be produced unless there was a very considerable current of that gas; and I do not know of any case where the lamps could be exposed to such a current in an explosive mixture in a mine so as to produce that heat. In this experiment the gas was applied to a very severe test of an inflammable mixture; that is, the gas was mixed with the purest air on the surface. In the mines the air is never perfectly pure, and the gas mixed with impure air will not readily explode. I can mention an instance in a mine where candles burnt with impunity in a mixture of carburetted hydrogen gas and carbonic acid gas, which when brought into and mixed with pure atmospheric air exploded; when the air is very pure, and mixing with the gas, it is then in the most inflammable state, and therefore this experiment only went to prove the cases which occurred at the surface, not in a mine.

1077. Under any circumstances of combination of gases which are to be found in mines, in what period, do you suppose, actual oxidation of the gauze would take place, and consequent decomposition of the wire?—I think it could only take place where the lamp is kept for a considerable length of time in inflammable mixture; such a length of time as no lamp ought to be kept in a mine, and I believe never is kept in a mine.

1078. Will you give the Committee a more definite idea of "a considerable length of time," according to your own apprehension of the result to be produced?—I should say, that a lamp kept in a state of red heat for a quarter of an hour would not produce injury. I could not state the precise period; for such an assertion might lead to its being kept longer than it ought, and especially as because in the mines my orders to the workmen are, that they are unsafe immediately they become filled with flame.

1079. Can you suppose such accidental circumstances in a mine, as that a sudden current shall set upon the lamp, so as to produce that certain degree of heat which will cause instantaneous explosion?—I should think not, except the lamp was exposed to such a current wilfully; I think the least degree of caution would prevent such a lamp from being exposed in such a way.

1080. Is it not possible, for what has been termed, in a former part of the evidence, "a bag of gas" to explode in the direction of the lamp, so as to produce the effect hinted at in the last question?—Such a case might possibly happen, that a sudden bag of gas bursting out might cause the lamp to explode.

1081. In many of the fatal accidents which have occurred, no one has remained to tell or to afford any reasonable conjecture how the accident happened?—In several of the very serious accidents the men are not left, especially where the explosion is very extensive.

1082. Is it not customary to attribute those accidents, on almost every occasion, to some act of carelessness on the part of the miner?—Knowing that the lamp in almost every case is safe, under ordinary circumstances, and as I can hardly conceive a case, except under very extraordinary circumstances, where the lamp kept whole would communicate explosion, it is generally attributed that, in the absence of every other evidence, something must have happened to destroy the security of the lamp, or that it had been done by carelessness. We know instances of carelessness that might produce such explosions; I myself have had instances of men taking the tops off the lamp, and being discharged in consequence of that, in mines that were inflammable.

1083. But if such carelessness was of very frequent occurrence, should we not much oftener hear of sudden explosions; would not that be a necessary consequence?—It certainly would; I should hope that those instances are not very numerous; but I believe that in a great many of the pits that are worked with lamps the atmosphere is not in an inflammable state at all times, only occasionally; and it is in a great majority of instances more as a matter of precaution against accidents that lamps are used, than that they are absolutely necessary; they are not generally in an explosive mixture, except on few occasions.

1084. But knowing that under certain circumstances those mines are liable to be, temporarily at least, in a dangerous state, no viewer would be justified in allowing such a mine to be wrought with candles, would he?—I think in any mine where such accidents are likely frequently to occur, and where the exposure in consequence of the use of candles would be serious, no viewer would be justified in using candles, such as in working pillars; but, as I before stated in my evidence, in working the whole coal gas may be thrown out in considerable quantities suddenly, which may produce only a partial explosion if accidentally ignited; in such a case,

a case, and where it is necessary for working the coal that it should be blasted, and candles cannot be dispensed with, I think a viewer is justified in using candles.

1085. In illustration of that last answer, have the kindness to produce a plan, which you stated that you had in your possession, proving that such a circumstance might happen in a bord, or a limited portion of the mine, as in the case of Killingworth colliery?—[*The Witness produced the Plan, No. VI.*]—The plan, No. VI., is a plan of the portion of the workings of Killingworth colliery, upon a small scale; the darts will show the direction that the current was moving in at the time this accident happened; the two pits near each other are down-casts, and the air is circulated through the workings in the manner shown by the darts, and it ascends up that part of the plan marked *staple* (being a small pit), and from thence it goes through all the workings of the colliery to the up-cast shaft in another district, which I have not here shown on that plan; after leaving the staple, the air traverses a circuit of several miles before it reaches the up-cast shaft. The accident happened at the place marked (a) upon the plan; and the plan, No. V., is an illustration, upon a larger scale, of a portion of the same workings. The mine was entirely lighted with candles; the workman, at the place marked (a), was working; he was holing the wall, or making a communication between two bords, and when the communication was just about being made, he tapped a back or fissure, which threw out a considerable quantity of gas: there was a small hole made between the boards at (a), by the workman striking his pickaxe through the coal, and immediately the gas was discharged with great force, and ignited at his candle, and burnt his face and hands; no other man, working in any other part of the mine, was injured at all. The explosion was so considerable as to set fire to the wooden partition or bratice in the bords, and it was only extinguished by being shut up. We could get no water to it or approach it for some time, owing to the smoke; and at one time we thought it would have been necessary to shut up a considerable portion of the mine in order to extinguish the fire, as at (b) on the plan. The explosion in this case was so little felt throughout the mine, that some men working at about 100 yards distance worked for six hours afterwards in the mine without ever hearing of it; and that occurred in a mine where there was a very considerable discharge of gas, and where, in some states of the weather, the discharge was so great as very nearly to bring the air generally to an inflammable point. Looking at the plan, No. V., it will be seen that the air which was conveyed into the workings where the accident happened was carried by means of a bratice, which, I stated before, only conveyed a portion of the air. If it had not been ignited by the candle, though the sudden discharge rendered it inflammable in the bord, it would not have been so when it mixed with the other part of the air, which shows that the air became first inflammable in the bord. In all the instances of working a coal mine with candles, when the ventilation is perfect the explosions are only partial; and it is only where the ventilation generally is deranged, by some accident or other, that serious accidents occur in working whole coal by candles.

1086. Do you suppose, in any state of the weather, a large colliery like this represented in No. V. is ever free from inflammable gas?—No, not such a colliery as that.

1087. You are aware of many collieries o very nearly equal extent to the colliery depicted in No. VI., which are not annoyed by the presence of hydrogen gas?—Very extensive collieries have no inflammable gas at all; others have it in a greater or less degree.

1088. Do you attribute that to the circumstance of the works not emitting the gas so much, or to the better ventilation of them?—The slatey coal emits very little gas. Some which have bituminous coals do not emit nearly the quantity of gas that others do; a very great proportion of the collieries in Northumberland and Durham do not produce gas.

1089. You have stated that that colliery, under certain circumstances, produced such a quantity of gas as nearly raised the mixture with atmospheric air to an inflammable proportion; do you consider that under such circumstances it can be justifiable to work a colliery with candles?—I think such a colliery may be worked with safety by candles, up to a certain extent; if the air is not inflammable in the bords, the mine generally, so long as the ventilation is perfect, is quite safe, and I should say that the limit would be, when it is not safe in the bords to work it.

1090. But supposing that any sudden irruption of gas had taken place from an

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old working, or that you had come unexpectedly upon a very extensive back, would not all the frightful consequences have ensued which have taken place under circumstances hitherto unaccounted for?—I have mentioned an instance of its coming in contact with a back throwing off a large quantity of gas, and no such consequence ensued.

1091. Cannot you suppose a much larger quantity thrown out under the like circumstances?—I think a much larger quantity thrown out would have produced a larger explosion, which might in some instances have produced loss of life. With respect to the old workings, I believe that the practice is never to work collieries in such cases without keeping a proper separation between the old workings and the whole coal workings, that no accident may arise by meeting accidentally with an old working, the practice being to bore always in approaching an old working.

1092. Are there not many districts which, having been worked in former times, were never correctly mapped or planned, and leave the miner at the present day in great doubt as to his approximation to those workings?—I believe in many cases the old workings are not correctly mapped; but in all cases the practice is to carry leading drifts in the direction of those workings, and to bore as they are approached.

1093. But supposing a back extending a very great distance in the direction of the old workings, may not that irruption of gas which has been presumed take place most unexpectedly?—I think it might; the working might meet with a back communicating with the old workings, which would throw out a great quantity; but I believe that the pressure in old workings, and consequent discharge of gas, is generally very much less than in meeting with bags of gas in backs, in whole mine workings.

1094. That is to say, that you apprehend the irruption from a back in an undisturbed strata will be much more violent and sudden than the mere irruption of a volume from an ancient working?—I do.

1095. And that, consequently, more time is given to the miner to escape the danger?—There is.

1096. Will you state any reason, on the score of economy or necessity, which should induce a miner to employ candles in the mine depicted on Plan No. VI. in preference to lamps?—I will explain the reason why I use candles in that mine in preference to lamps; the reason is, the coal is of such a nature that it cannot be wedged down. The mode of working coal is either by blasting or by wedging; the coal of that part of Killingworth colliery is of that hard nature, and the tenacity with which it sticks to the roof is such, that I believe it cannot be worked to profit without blasting; and my reason therefore for working it with candles is, that it would not, with the use of lamps, be worked to profit.

1097. Then in consequence of the necessity of using gunpowder, candles are substituted for the lamp, as occasioning no additional danger or risk?—The necessity of using gunpowder increases the use of candles, and I think in that case, with proper care, candles may be used with safety. The mode of working the colliery is varied, of course, according to the quantity of gas met with; leading drifts in some cases are driven, to tap, as it were, the mine before the general workings approach that part, and, as it were, to explore the danger; and in some degree these leading drifts draw off the gas, keeping the main body of the workings more free from such casualties.

1098. If scientific experiments could satisfactorily prove the possibility of blasting with gunpowder under circumstances such as to prevent ignition to surrounding gas, would you have then any objection, in the case described, to substitute the use of the lamp?—I think not, except so far as regards economy. I believe that the desire of the coal-owners is so great to secure safety of the workmen and mines, that I think, to a certain extent, they would not hesitate in using lamps instead of candles, if the miners were to be more safe in consequence; but I have some doubts in my mind whether the general use of lamps in mines that perhaps are never, or very rarely, dangerous by an inflammable mixture, would be a saving of loss of life.

1099. Will you state to the Committee the process of reasoning by which you arrive at that conclusion?—Perhaps in the course of my answer I shall allude to the evidence of one of the witnesses before the Committee, Elliott. It has always been my impression, that if lamps were generally used where mines are scarcely, if ever unsafe, that it would produce a greater degree of carelessness in the men in the use of their lamps; and I must say that that impression was much confirmed

confirmed by the answer given by the witness Elliott, who of course has a much better opportunity of judging practically of the habits of the miner than I myself have, who am not so constantly amongst them. This confirms my belief that where the men know that they may use the lamp with impunity it would produce a sort of carelessness, which I think might, in some cases, be very destructive of human life; because although the accidents where candles are used are probably as numerous, or more so, than where lamps are used, yet when an explosion does occur where lamps are used it is generally very fatal. In one part of the mine adjoining Killingworth we were liable to sudden and occasional discharges of gas, and the coal was obliged to be blasted with gunpowder. I enforced the use of lamps by the men, and set other men, in whom confidence could be placed, to fire the gunpowder; and I abandoned this mode of proceeding from the conviction that the mine was much safer by having candles entirely in it than by using lamps occasionally, and setting men to blast the gunpowder; entirely from the experience that any use of the lamp, except where absolutely necessary, produced a sort of carelessness in the workmen.

1100. Are there not many cases in which the mines could not be wrought without the daily and hourly use of the lamp?—There are a great many mines which could not be worked without the use of the lamp, and where lamps are always used; those are principally pillar working, where the mine does not require to be blasted with gunpowder, and where the discharge is such as to render the mine frequently dangerous. In all those cases lamps are used.

1101. In the mine described in No. VI. have you removed any of the pillars?—We have not.

1102. How do you expect to be situated relatively with regard to foulness when you come to pillar working?—I think when we come to pillar working we shall have a considerable quantity of gas, and shall then be obliged to use lamps.

1103. Having already occasionally so much as to raise the mine to a point of ignition, you will be under the necessity of abandoning candle-light altogether?—In pillar working we of course abandon the candle-light, but in working the pillars the weight of the superincumbent strata causes the coals to be worked more easily, and in that case it can be worked without gunpowder, and lamps can be used.

1104. As pillar working commences very gradually, whose duty will it be to ascertain the day and the hour upon which the lamps must be introduced?—The pillar working will be determined upon by the viewer, the precise day on which it begins, and the mode in which it is to be carried into effect, and the lamps will be used immediately on the commencement of the pillar working.

1105. The pillar working is always attended with great danger?—The pillar working renders a mine more inflammable, inasmuch as you cannot produce a perfect ventilation.

1106. Is the value of the pillars sufficient to the proprietor to justify him in encountering that danger?—They are; and I should not say that there is more danger in working the pillars than in working the whole mine, because in that work the lamps are entirely used.

1107. Is it always the practice to get out those pillars?—Always, and in deep mines the pillars constitute three-fourths of the coal, and as a consequence, in those cases three-fourths of the coal would be lost if the pillars were not worked.

1108. Are they worked at a greater or less expense than the other portion of the coal?—There is not a very great difference in the whole expense, compared with the produce, of one with the other.

1109. How many men and boys may you have under your immediate superintendence?—I really cannot say precisely the number; some hundreds.

1110. Five hundred?—I should say above 1,000.

1111. How many years have you had this charge?—The numbers have varied at different periods; I have had the charge of fewer at different times.

1112. Will you say, for the last 15 years, how many have been, more or less, under your notice?—I should say above 500.

1113. For 15 years have you had an average of 500 men and boys under your superintendence?—Yes.

1114. Can you give the Committee an idea of the number of fatal accidents, in the way of a per-centage, that have occurred to 500 men and boys in the last 15 years?—At Killingworth colliery, which is the most extensive mine under my charge, there are about 300 men and boys employed under ground.

1115. May Killingworth colliery be considered a fair specimen of a fiery mine

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in Northumberland, neither exceedingly explosive nor liable to very partial eruptions of gas?—In working the whole mine of Killingworth, I should take it to be rather above the medium of danger; in the pillar working it is a safe colliery, so far as the average quantity of pillars have been worked, but on the whole I should take it to be about the average.

1116. Will you endeavour to form an idea, to the best of your recollection, or from any particulars in your possession, of what the average loss of life has been, as a per-centage upon 500 men, in the space of 15 years?—I cannot state precisely the number that have lost their lives by explosion within that period, but I think it does not amount to more than eight or ten in the whole period; I think not more than 10.

1117. Have many others received grievous wounds and injuries?—We have had a great number of small fires, such as I have described in the bords in the whole coal workings, which have hurt men, but they have almost always recovered; but I cannot state to what extent that may have been. I myself was burnt on one occasion along with three or four more, but it was slight.

1118. Was that in the ordinary course of your professional duty, or in experimenting upon this subject?—It was in the ordinary course of my professional duty.

1119. Will you state the circumstances which led you into such danger personally?—It occurred in a part of the mine where there was a blower of gas.

1120. Were you aware of the existence of that blower?—I was. The ventilation of that blower was kept up by two doors, and if those doors were neglected the ventilation was interrupted.

1121. That is to say, if the doors were periodically opened and closed, the mine became foul?—If the doors are not kept shut, or shut quickly, the mine becomes foul to a certain extent.

1122. Are not those doors entrusted to very young children?—They are.

1123. Do you think it justifiable, where an explosion depends upon a child of nine or ten years of age doing his duty, that such parties should be employed in such cases?—I should think that the expense of employing men in such operations would render a great many collieries unworkable to profit.

1124. But do you think, from your own experience, that the men would be more attentive than the boys in that duty?—I have some doubts upon that; I think the boys are generally very attentive; the men ought to be more so, as knowing better what the consequences may be; but in the case of Killingworth, where I believe there are about 50 such boys employed, we have very seldom had to complain of such neglect occurring to endanger the ventilation of the mine.

1125. Do you mean to state that it would be necessary to employ men at all those stations?—No, I think not, as any one door would not interrupt the ventilation of the air to any extent.

1126. Do you not think that it is the bounden duty of the viewer to station such men as he can have implicit confidence in to have the charge of the doors that are of such importance for the general ventilation of the mine?—I must observe that there is a considerable check over the boys at the doors, by people passing backwards and forwards continually, who see whether they perform their duty or not; and it can only be in very extraordinary cases where doors can be neglected, and where the men and boys passing backwards and forwards do not detect the neglect of the boys.

1127. Do not you apprehend that the very circumstance of neglect from which you were a personal sufferer might have led, under certain circumstances, to the most calamitous results?—I think not.

1128. Will you give the Committee the reason?—I think in that case the number of people passing and repassing through the doors would occur so frequently, that they must have seen the neglect before any serious accident could arise.

1129. How came it that a gentleman of your experience did not at once ascertain the state of the mine?—The door, when I went there, was shut, and it is not customary in going through the pit, except where danger is apprehended, or where sudden discharges are likely to be met with, to go exploring the state of the air in the mine, except to observe the current that is going through. When I went into this place the current was going as usual; the door had been neglected a short time, and shut before I approached the place; and it was in a situation where the explosion was necessarily confined to a smal lspace.

1130. For

1130. For what length of time do you suppose this neglect had occurred which led to these consequences?—I should think probably five minutes.

1131. If the safety of a great number of men is to depend upon a child of nine or ten years of age neglecting his duty for five minutes, can you reconcile any master placing his men under such circumstances?—I cannot see that any other mode can be pursued. I am not quite sure how far a man would attend to his duty better than the boys, or whether men could be got, except at such a rate of wages that would render the mine unworkable to profit.

1132. Do you find in practice that the men are themselves, when their own personal safety is concerned, perpetually observant of the regulations of the colliery?—I have had three instances where men have taken the tops off the lamps, where the mine at that time was certainly not in an inflammable state, but where it was so a very few hours after.

1133. Is it not the case that the children, as you say, are continually liable to the check and the reproof of the parties in authority that are passing through the colliery?—They are.

1134. Do you think that an adult stationed to perform the same duty that those children do, could be kept in such good order by the pitmen under ground as the boys themselves are?—I should think that there would be very little difference in the degree of attention: I think the boys are kept under more awe of the men who look after them than the adults would be, and consequently more likely to be attentive.

1135. How long does one boy attend to each door?—The whole of the time that the pit is at work.

1136. How many hours is that?—From the time he goes down the pit until he returns; 12 hours.

1137. In regulating the rate of the steam-engine at the time that coal corfs are ascending, is it usual to moderate the force of the engine at the time that the ascending and the descending corves pass each other?—It is, where both the corves pass each other in the same compartment of the shaft, or where, as in a great many instances, there is no division or brattices between them.

1138. To whom is that office entrusted of regulating the speed of the engine?—To the person who works that engine.

1139. Is that part of his duty performed by the man himself, or entrusted to a boy?—It is always performed by a man.

1140. Are not liberal wages paid to men so employed?—They are; the men so employed make a sort of servitude before they are entrusted to such an office.

1141. Is it not of the first consequence to the coal-owner that such men should be exceedingly careful and diligent?—It is.

1142. Would not any neglect of duty on their part be to throw the mine off work more or less?—It would; and they are always discharged for any neglect of duty.

1143. Are you acquainted with Felling colliery?—Only from report.

1144. Did you ever descend down that?—I have not.

1145. You are aware that a great loss of life has taken place in that colliery?—I am.

1146. Has your local residence brought you acquainted with any peculiar circumstances attending the state of that mine?—I am viewer to the mine adjoining to Felling colliery, and the only knowledge that I have of it is from report, and that it is working in the pillars.

1147. From your immediate proximity with the adjoining coal field, do you consider that a remarkably fiery stratification?—I think it is.

1148. Do you know of any more so?—I should say, that at present it is not so dangerous as it was some time ago; I know of several that are more so at present.

1149. Were you in the neighbourhood in October 1821, when six men were reported to have lost their lives in that colliery?—I was not a viewer at the adjoining colliery then, but I lived at Killingworth, and heard of the accident, but I cannot give any account of it.

1150. Is that the last accident that has taken place in that colliery?—So far as I know.

1151. Can you give the Committee any information relative to the accident in 1812, by which 92 men are reported to have lost their lives?—No, I cannot.

1152. Nor in December 1813, when 22 men are reported to have lost their lives?—No, I cannot.

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1153. Are you acquainted with Jarrow colliery?—Only from report; I was never down Jarrow colliery.

1154. Are you acquainted with Russell's Wallsend colliery?—Only from report.

1155. Have you ever descended that colliery?—No, I have not.

1156. Will you state any colliery in the county of Durham or Northumberland which you think affords the most striking proof of the existence of carburetted hydrogen in indefinite quantities?—I should say that the Bencham seam, at Wallsend colliery, is the most inflammable of the two rivers.

1157. Do you think it possible, under every care which can be bestowed, to work that seam without the contingency of occasional explosions?—I should think scarcely; I must, however, beg to state, that not having been down the pit, I cannot speak so positively as I could otherwise do.

1158. But your impression is, from all that you have heard, that the quantity of gas is so great that no discovery of science hitherto made can be considered a certain protection to the miner?—Not a certain protection; I think this colliery is extremely liable to accidents by explosions.

1159. Are you liable at Killingworth colliery to have men drawn over the pulleys?—Not more than other collieries; I do not know any instance of a man being drawn over the pulleys at present; I believe such accidents are extremely rare.

1160. In the trade generally, do you mean?—In the trade generally.

1161. Are not the workmen allowed to place themselves in the baskets and on the ropes promiscuously?—No; the onsetter, that is, the man who hangs the corves on at the bottom of the pit, has a check upon the number that is to ascend upon any rope.

1162. Is there any rule or prohibition by which they are prevented from clinging to the rope merely, without entering the basket?—In pits where both the ropes go in the same compartment they are not allowed to ascend in the baskets at all; it is considered much safer to descend and ascend upon what are termed loops than in the baskets, and it is only where the ropes are divided by a partition that the men are allowed to descend in the baskets, and that not from any greater degree of safety, but because coals are drawn by the other rope at the time that the men are ascending the opposite one. I consider it much safer to go up and down in a loop than in a corve.

1163. Have you never seen men or boys ascending with their legs twisted about the ropes?—I have done so frequently myself, and it is a daily practice.

1164. Do you consider that it is justifiable to allow such a practice?—I think so, inasmuch as very few accidents happen in consequence; I do not know of any instance of accidents happening except by something falling down the pit, which I think would have been as fatal to the men in the loops as to the others upon the rope.

1165. But supposing the case of three men, or of boys, one above the other, and the uppermost losing his hold, what would be the consequence?—He might or might not drop in such a way as to knock the others off the rope.

1166. Is not the probability that he would slide till he struck the next man?—I think in such a case he would fall; he would not slide down.

1167. Is not it the case when they ascend on the loop that the lower has his leg through the loop, and the others are resting upon him?—No. There is a sort of noose or loop; two men generally ascend together, with their opposite legs within that noose, and when two corves are drawn, two men are in the loop above that; and if there are any clinging to the rope they are at such a distance from the others as not to touch them.

1168. In coming up on the rope the men extend their arms in succession to the banksman, who plucks them off on the landing-place?—That is the practice.

1169. And if he should happen to miss the banksman, would he not be drawn over the pulleys?—I think not; the attention of the brakesman, who works the machine, is directed by a bell when the rope is approaching the surface, and his attention of course is more particularly directed to what is going on when the men get to the surface; and in a case of that kind he would stop the machine immediately.

1170. Do you think that it is possible for the brakesman to stop a machine before the man reaches the pulley frames of the ordinary height?—I think it is.

1171. Can the men disengage themselves from the loops with equal rapidity as from

from the smooth rope?—They are pulled out of the pit with the rope, and made to rest upon the settle-boards, or platform at the top, before they disengage themselves from the loop.

1172. But cannot you suppose many cases in which a man leaving his work ascends on the rope without any warning to the brakeman that anything other than the coal is ascending?—The universal practice is, either that the onsetter calls to the banksman who is at the top, and the banksman calls to the brakesman, or a signal by a rope, or such like, is sent to the banksman upon the corf that is drawn previous to the men being drawn, which is to inform the banksman that men are about to ascend. The time which is occupied before the men get into the loop, and before they begin to ascend, they likewise call out to the banksman to draw them up, which is not done when the corf comes away. All those signals are matters of precaution to warn the brakesman that men are about to ascend.

1173. When they ascend by those loops, are they disengaged at the top without any cover being placed over the pit?—Yes; they are taken hold of and dragged upon the platform with the end of the rope.

1174. While the machinery is in motion?—No; the machine is stopped when the men get up to the top of the pit; then they are dragged upon the platform by the banksman, and the machine is reversed, and they are thus made to rest upon the platform.

1175. Then at the moment of their being disengaged from the loop is there not a cover on the top of the pit?—No, the pulleys are very high in the Newcastle district, and do not require any.

1176. How are the corves landed on the top?—In the same way.

1177. There is no sliding-frame thrown over the top of the pit?—No; the pulleys are placed at such a height that a man taking hold of the corve brings it upon the fixed platform.

1178. Are the workmen furnished with printed instructions, both as regards the risk of being burnt from fire-damp and the dangers incident to their occupation in ascending and descending the mine?—They are not warned by printed instructions; they have warning verbally that they are to observe such and such precautions, which are considered advisable by the overmen and others employed to superintend them.

1179. Do not you think that it would have a good effect to place simple, clear instructions, drawn by the viewer, in the hands of every workmen and boy in print annually?—I should say that such a thing would do no harm, but I think it requires a continual enforcement of those instructions to impress a man, or the boys, with the necessity of practising them.

1180. Supposing five men to come from the lead mining districts in Northumberland to work at the colliery in Killingworth, whose duty would it be to apprize those men of all the risks attendant upon their new occupation?—The men who have charge of the different departments. In the operations of working the colliery there are men placed who have charge of all the various departments of the operations going on; and those men are furnished with and know everything that is necessary for conducting the mine properly, and they attend to and enforce what is necessary on strangers.

1181. Do you think that one of those Alston men would hesitate to swing on to the rope while the onsetter's back was turned, and thus ascend the mine without giving any warning whatever?—It would be neglect of the onsetter to be out of the way when the men were ascending, and I think if the onsetter was absent, unless they were wholly strangers who wished to ascend, and which could not be the case, the other men would guard him against such an occurrence.

1182. But can you suppose a case, in which the signal to draw having been given, and the corf not raised, such an occurrence might arise?—I can conceive that such a case might arise.

1183. But in fact you do not know of any such case?—No; nor do I think it likely.

1184. Has the onsetter the authority to prevent the men coming up in an improper manner?—He has.

1185. After the last strike of the pitmen had you any men from the lead mines employed in the Killingworth colliery?—No; but at other collieries there are a good many.

1186. Do you find that those men meet with more accidents than the old experienced pitmen?—No, I think not.

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1187. Is not the stratification so different in different collieries, that it would be almost impossible to lay down one plan for the working of every colliery?—I think in all the collieries there is one principle of ventilation which is the best, but the mode of conducting that ventilation will vary in every different case.

1188. Have you seen a plan of Mr. Martin's since you came to London?—No, I have not.

1189. Suppose a commission of scientific and practical men were appointed by Government, or in any other way, for the purpose of examining the different mines of the kingdom, and making experiments upon the spot, do you not think that it might be the best means of effecting the objects of this Committee?—I think an examination of all the mines perhaps, by individuals practically acquainted with the subject, would have the effect of diffusing a mass of very useful knowledge over the whole, which I think might be of service.

1190. Is it not probable that they would arrive at more useful results than they could do by examinations and experiments in their own laboratories?—I think decidedly so; I think to arrive at any useful result, it should be done by men practically acquainted with the subject, and in mines, and not in laboratories on a small scale.

1191. You mean making their experiments upon the spot?—Yes.

1192. Are you aware of the existence of a society in Cornwall, in the mining districts of the West of England, called the Cornwall Polytechnic Society?—No, I am not.

1193. Do you consider that such a society, having for its object investigations connected with mining, and patronized by all the leading men of the neighbourhood, permitting access to its debates and experiments to the lower class of mechanics, would be useful in the north of England, in calling forth native talent, and in diffusing information on subjects so interesting to mining and humanity?—I think any society which would have for its object the acquiring and diffusing information upon the subject of mining, and patronized by the leading gentlemen of the district, would be very useful.

1194. Do you think that many of the working men, hewers, overmen, deputies, wastemen and enginemen, would be likely to take an interest, or join themselves as members, at an annual subscription of 5 *s.*, to such a society?—I really cannot say whether they would or not; I see no objections to it, and I do not see why they should not.

1195. Do you think that information or the love of reading and scientific research is on the increase in the mining districts of the north of England?—I think the love of reading is on the increase; I think the overmen, and those men also who have charge of the different departments, are more intelligent than they were when I first knew the trade.

1196. Do you think that moral character generally, and that the moral habits of the mining population in the north is improving or otherwise?—I am afraid there is no great improvement in that respect, except in the rising generation.

1197. Do not you think that an opening for such purposes as has been alluded to by the formation of a polytechnic society would have a favourable tendency?—I do not exactly understand the objects of it; if I saw the rules I would be enabled to give a more decisive answer to the question. I think any society that would diffuse practical knowledge would be useful.

1198. You have been asked whether it would not be expedient to put printed regulations in the hands of all the pitmen; in point of fact, what proportion of the pitmen are able to read?—I should say a very inconsiderable proportion of the grown-up pitmen can read.

1199. In signing the pit bonds, is it not the case that perhaps there is not one in 50 that can sign, otherwise than by a mark?—They always sign by a mark; they refuse to write, even if they can.

1200. From the age that the labour of boys begins to be profitable in the colliery districts, is there any more chance of parents sending them to school between the ages of eight and twelve than subsequently?—I think in most of the collieries there are schools patronized by the owners of the collieries, and the boys have an opportunity of attending schools at nights, and also when the pits are off work. The pits are not worked more than 11 days, and very often a fewer number of days, in a fortnight, and they then have the opportunity when the pits are off work of attending schools.

1201. Do they, in fact, make use of that opportunity, and go to schools when the

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the pits are not at work?—At nights they do, I think; it is not so much practised in days when they are off work.

1202. Is it the case that the rising race of pitmen are likely to be better instructed, by the care of their employers, than the last race were?—I think the pitmen, generally, are more intelligent than they were; but their habits are, not to acquire much knowledge about what is going on in the pits; they exhibit a sort of indifference in that respect.

1203. You have stated, that of the grown-up pitmen a very small proportion can read?—Perhaps it was the extreme in stating a small proportion; I think an inconsiderable proportion, as compared with the rising generation, can read.

1204. But you say that the proprietors have established schools in the collieries, and that they do encourage the parents to send their children there?—Yes.

1205. Are there Sunday schools also?—There are.

1206. Sunday schools in connexion with the different congregations of dissenters?—Yes, there are.

1207. Have any infant schools been introduced into any of the collieries?—I do not know of any except schools kept by the widows, in which schools they take children at very early ages, which are, in some degree, infant schools.

1208. But you do not know of any instance of a large school, upon the principle of the infant schools which exist in the great manufacturing towns, having been established near those collieries?—I do not recollect any.

1209. Should you not think, as the labour of the children becomes profitable at so early an age, and parents are unwilling to spare them from the collieries, that it must be desirable to follow the plan of infant schools; before their labour becomes important to give them some instruction?—I think an effort was made at Killingworth to establish an infant school, but the schools kept by widows in some degree rendered it unnecessary; I think it desirable that the children should have instruction at the early ages alluded to.

1210. Supposing 100 men lost by the explosion of a colliery in this week, do you think that there would be any difficulty in supplying their places in the same colliery within a fortnight?—I think not.

1211. Would the men take employment in the same pit without inquiring as to any change of the ventilation or the relative danger of that colliery?—I think the men would make inquiries upon the subject; and, as the practice is to put the mine into a proper state of ventilation as soon as possible after such an explosion, the result of those inquiries would, of course, be favourable, which I presume would be the cause of their going so soon to work again.

1212. And there would be no difficulty in procuring the required number?—I think not.

1213. With respect to the lead miners that you had at Springwell colliery, did they show any alarm in first going down the mine?—No; not of any consequence.

1214. Do you find, where the father of a family has lost his life by accidents in mines, there is any unwillingness in the mother to bring up the children to the same employment?—No; I never knew an instance where such an unwillingness was shown.

1215. Have you any knowledge of the lead mining districts of the north of England or Scotland?—My knowledge upon that point is very limited; I have a small share in a lead mine, and have the management of it, in Northumberland, but it is only worked to a limited extent.

1216. Are you acquainted with any of the collieries in Scotland professionally?—I have been through some of the collieries in Scotland.

1217. Are any of those subject to fire-damp?—To nothing like the extent as in the north of England.

1218. To what mines do you now allude?—I allude to the mines at Halbeath, in Fifeshire.

1219. Is carburetted hydrogen present in those mines to a dangerous extent?—I should say not.

1220. Are the safety-lamps in use in any of those mines?—I cannot state that at present. I believe Lord Elgin's colliery in Scotland is considered the most bituminous, and consequently emits the most gas; the coal in Scotland generally is of a slatey and not caking quality, and that quality of coal very seldom emits any gas.

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1221. You are not aware of any fatal explosions having occurred in Scotland?—Not from fire-damp.

1222. Are you acquainted with the coal mines in any other part of this kingdom than those to which you have already alluded?—I have been employed in mines in South Wales, and I have been down mines in Derbyshire, Cheshire, Staffordshire and Cumberland.

1223. Are any of those mines subject to the same danger as the mines of the north of England?—One of the mines in South Wales, the Hendreforgan mine, is a stone coal or anthrasite, and I sent a person there as a manager, who is there at present: I occasionally went over some years ago, and in that mine there was a considerable discharge of inflammable air, and I believe some accidents have happened. Once the manager was very much burnt, and some others.

1224. Are the safety-lamps in use in that mine?—I cannot state that they are at present. I sent some over from the north to it, but I cannot say in what state the mine is in at this time.

1225. Is it still under your care?—No.

1226. You do not, then, consider yourself responsible for any accident that may arise from the non-introduction of the lamps?—Not at all. In the other mines that I was in, in Derbyshire, Cheshire and elsewhere, the quantity of gas was very insignificant, compared with that which is met with in the north.

1227. Are the miners in either of the districts to which you have last alluded, subjected to dangers unknown to the miners of the north?—In Staffordshire, in a very thick seam, the miners are more subject to be crushed, by accidental falls from the roof, than they are in the north, from the great height of the seam; but I should say the liability to accident from gas is very much less.

1228. Those falls, by which the men are crushed, are accidents against which no foresight can effectually provide?—I think they are.

1229. Are you acquainted with any of the coal works in North Wales?—I have been in a mine at Ness, Sir Thomas Stanley's, but that is the only one that I have been in, and it appeared to me not to be a dangerous mine.

1230. What is the thickness of the seam?—There are more seams than one; the seam that I was in I think was five feet thick.

1231. Little or no danger exists in that mine with respect to gas?—I think not, as compared with the collieries in the north.

1232. You say that the danger in the thick mines in Staffordshire arises principally from falls in the coal?—I think that is the principal danger.

1233. Do you think that no foresight could prevent that?—So far as I was able to judge from a casual visit, no other precaution than that generally used could be of benefit in that respect.

1234. That is supposing the mines to work upon their present plan; but did it occur to you that some other mode of working them might be adopted, by which the danger would be less?—I had not time to consider the subject sufficiently at that time to enable me now to give any useful answer.

1235. What was the thickness of the seam?—Thirty feet.

1236. Do you think if a portion of that coal was taken, if it were worked in slices of 10 feet at a time, the danger might not be lessened?—I cannot give an opinion upon that. It struck me when I was there that there was a very great waste of coal.

1237. What was the quantity left behind?—I understood that a third was left behind.

1238. Where was that?—In Staffordshire, near Wolverhampton.

1239. In recurring to the general tenor of your examination, have you anything to suggest which you think would be interesting to this inquiry?—I think there is one omission that I made when I was asked the question about the air-pump, and also the extent of ventilation of the mine. I was asked as to the velocity of the air in a tube five miles in length. In the extensive collieries the ventilation by one shaft is in some cases upwards of 100 acres of superficial area of excavated coal, and this extent requires a current to be sent through the workings equal to 20 miles in length; the current has to traverse 20 miles in length to sweep over all the excavations in extensively-worked collieries.

1240. You are aware of the report of a very fatal accident having occurred during the last week at one of the collieries on the Tyne; have you any observations to make upon any of the circumstances which have come to your knowledge as connected with that explosion?—I do not consider myself in a situation to give any opinion

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opinion relative to that accident. With respect to the question that has been asked, as to whether I could point out anything that might be in furtherance of the object of this inquiry, which I presume to be to endeavour, if possible, to prevent accidents in the coal mines, and at the same time not to enhance the price of coals unnecessarily to the consumer, I mentioned, with regard to the safety-lamps, that some defects existed in each of those lamps. I think it would be extremely useful if experiments in the mines could be made upon the different lamps by practical men. I likewise think if this Committee would furnish to the public the evidence which is given here it would direct the attention of practical and scientific men to the question, and to the lamps or modes of lighting and ventilating that have been presented to them. If these were furnished to the public, and the coal-owners would institute a set of experiments upon each of the lamps submitted to their notice, I conceive that it might be attended with some beneficial result; and if that were followed up by a premium offered by the coal trade generally for the best mode of ventilation, or best manner of lighting mines, it would, in my opinion, be still further likely to be useful. I think the information which will be obtained by this Committee will furnish scientific men with all the minutiæ of the operations of coal mining, together with the manner in which gas is met with in the mines, than they have hitherto been furnished with, and that they will consequently be better able, by knowing the defects of the system, to devise something that may be useful. I have stated the defects in the lamp, which I think absolutely necessary, in order to direct the attention of scientific men to those defects.

1241. Would it not be very useful if the mines could be lit without the use of either lamps or candles?—Certainly it would, if such a mode of lighting would allow blasting the coal with impunity, or that some plan could be devised of separating the coal from the mass where wedging cannot be beneficially practised.

1242. Have you heard of the plan proposed by Mr. Gurney?—I have heard of that plan.

1243. Do you see any difficulty in the way of that plan?—I see very considerable difficulties in the way of it, from the number of times the light would have to be reflected, and the very great difficulty of doing so in an atmosphere saturated with dust and impurities, and where the passages are interrupted by the numerous doors having to be opened and shut continually.

1244. Are you aware that he states that there is no difficulty as to conveying the lights through those doors?—No, I am not.

1245. That he would have an orifice of six inches square at the door?—I should say, in that case, the dirt and dust of the mine, and the light having to be reflected several hundred times to light the whole of the pit, would render such a mode of lighting extremely difficult, if not entirely impracticable.

Mr. *George Johnson*, called in; and Examined.

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1246. YOU are extensively engaged as a viewer in superintending the working of coal mines in the north of England?—I am.

1247. You have heard the evidence given by Mr. Wood as to the general character of the coal stratifications of the north of England; does that evidence agree with the result of your own observation?—It does.

1248. Do you agree with him also as to the different kinds of gas which are met with in the course of coal-working in the north?—I do.

1249. In the mines with which you are acquainted, how is the ventilation carried on?—On the same principle as that described by Mr. Wood; of course in different mines there are different ways of carrying it on, but the same principle is adopted generally.

1250. Do you consider the furnace the most valuable auxiliary to ventilation that you are aware of?—The most valuable.

1251. Are you aware of the application of the air-pump having been found effectual?—I have known an instance where the air-pump has been used.

1252. Has it been discarded?—Yes.

1253. And by what replaced?—By the furnace. At Heaton colliery, the colliery where I am the viewer, the air-pump was used, when I succeeded to the management, for the ventilation of the mine, and I found it was not sufficiently powerful to cause a proper ventilation of the mine.

1254. How would you convey to the Committee an idea of the powers of exhaustion which that machine possessed?—I cannot give an idea of its powers exactly,

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exactly, because at the time I did not enter into a minute investigation, further than to satisfy myself that the ventilation underground was not a perfect one; it was not a satisfactory one to me, nor was it proper that I should allow it to continue in that state.

1255. You conceive that you tested the machine to the utmost of its power, and that it was still inefficient?—Yes.

1256. Do you know the size of the working barrel?—I find, by referring to Mr. Buddle's notes, by whom the machine was erected, that the piston was five feet square, with a stroke of eight feet, and the valves were one-third the size of the piston; and Mr. Buddle states that it went 20 strokes per minute.

1257. Had Mr. Buddle ever an opportunity of making experiments as to the power and efficiency of that machine?—Mr. Buddle was the viewer of the colliery before I went to Heaton, and it was constructed by him.

1258. Then if Mr. Buddle should be called before this Committee, he will be able to furnish to it the result of his experiments upon that machine?—He will.

1259. Do you consider that the mine with which you are acquainted is above the average of the danger from the fire-damp, or subject to pretty much the same infusion of gas that other mines are in your neighbourhood?—One of the collieries I manage, the Wilmington colliery, belonging to Mr. Bell, the Honourable Member for Northumberland, gives out a large proportion of inflammable gas.

1260. In consequence, have you been subject to many and fatal explosions?—Only one of any consequence.

1261. When did that happen?—I think it was in September 1831.

1262. Was the loss of life considerable?—There were four men and four boys killed, and seven were severely scorched; but I ought to state that this accident was not caused by the state of ventilation in the seam in which we were working, but from a blower met with in a Bensham seam, 38 fathoms below the high main coal. This Bensham seam had been arrived at by a staple sunk at some distance from the main shaft; a considerable blower was met with, which we were necessarily obliged to bring into the main air course in the upper seam. A violent eruption of this gas came off, met with the candles of the workmen in the upper seam, and caused an explosion.

1263. Then this communication of inflammable gas to the upper seam was purely accidental?—It was.

1264. Had you any warning of such a contingency?—The emission of gas was great before that period; I got alarmed, and I allowed the workings in the Bensham seam, which were very limited, to fill up with water, conceiving they would fill up gradually, and by that means the whole space in the Bensham seam would be filled with water.

1265. You are alluding to the water in the Bensham seam?—Yes; the water appeared to fill the seam, and rose up the staple 13 fathoms, but the gas had been so powerful as still to leave a considerable space, I conceive, near to the orifice of the blower, and at last to force its way through the water in a great body. The gas came in contact with the lights of those men, and caused the explosion.

1266. That is, your conjecture of the water gradually filling up the waste in the Bensham seam was not realized?—It was not realized.

1267. And in consequence, a certain quantity of gas which had been pent up by the pressure of the water forced its way up into the upper seam?—It did.

1268. Did that come with any loud noise or other indication?—None; the only notice that was given was by the explosion.

1269. Were you at that time working the upper seam with candles?—Yes.

1270. The mine at that time was worked with candles?—Yes, in that particular part.

1271. Previous to this circumstance, had you been obliged to introduce candles into that portion of the mine?—Not into that portion of the mine.

1272. You had no reason to apprehend that any sudden though limited eruption of carburetted hydrogen into the upper seam would raise the atmosphere in that mine to an inflammable pitch?—I had not such an apprehension.

1273. Then you conceive that it was one of those accidents against which no foresight could have provided?—It was a matter that I did not foresee or contemplate.

1274. The idea never suggested itself to you that a pent-up magazine might be formed in the Bensham seam?—I conceived that the water having fallen into this seam would have filled up all the working places; but so far from that, the strength

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of the gas, I think, kept the water back from the blower, and it increased in strength and magnitude till it forced its way through the water into the upper seam.

1275. Do you consider that there is still a gaseous communication between the Bensham seam and the upper seam?—After the accident, I thought it was necessary to shut up the Bensham seam entirely, therefore I closed the staple up by putting a strong cap of iron over it, into which I introduced a three-inch iron pipe, and by that means bring the gas to the surface, where it is burnt.

1276. Do you mean to say that there is still a constant rush of inflammable gas from the Bensham seam, through this pipe which you have mentioned, to the surface of the earth?—Constantly.

1277. Do you ignite that?—We burn it every night.

1278. Do you burn it to get rid of it, or to illuminate the works?—It illuminates part of the works at the pit heap on the surface.

1279. What is the height of the flame constantly emitted?—Generally about a yard high.

1280. This light, of course, can be seen from all the neighbouring country?—From a considerable distance.

1281. Does it burn with a bright yellow flame?—With a bright flame, except where it first issues out of small apertures of the *burner*; it is then very blue; after being mixed with atmospheric air it burns with a bright flame.

1282. Do you consider that there is still a decided pressure on the gas from the Bensham seam from the presence of water, or is it nothing more than the natural pressure of the superincumbent strata?—This gas being a lighter body than atmospheric air, ascends up this pipe with great rapidity; there is still a considerable supply of gas from this blower.

1283. Have you made any calculation as to the number of cubic feet which is emitted in any given time from this aperture?—I have not.

1284. But this experiment shows that, independent of what is emitted in the course of working the mine, there is a very large exhalation from the coal not in a state of working?—Yes, there is.

1285. Have you been personally interested or professionally employed in any other mines in which those fatal accidents have occurred?—About 25 years ago I was on the river Wear; this was previous to the introduction of Sir Humphrey Davy's lamp.

1286. Will you name any particular colliery?—I was at Flatfield colliery.

1287. Were you there in the year 1813?—No.

1288. Do you ever recollect hearing of an accident that happened there in September 1813, by which it is reported 32 lives were lost?—I have no doubt that I would, but I do not recollect the circumstance.

1289. Were you in the neighbourhood of New Bottle in the year 1815?—I left the Wear in 1810.

1290. Were you in the neighbourhood of Picktree in the year 1794?—No.

1291. Will you give the Committee any case of accident on the Wear, or in that vicinity, during the period of your residence there?—I recollect an accident at Oxclose, where there were upwards of 40 people lost by an explosion.

1292. Is Oxclose near Chester-le-Street?—Not far distant.

1293. In what year was that?—I do not remember precisely, but I went to the Wear in 1802, and left in 1810.

1294. Are you able to state to the Committee any particulars of the accidents that have occurred?—No, I am not prepared to state any particulars of those accidents.

1295. Are you acquainted with Jarrow colliery?—I am, slightly.

1296. Have you ever descended the workings of the colliery?—Yes, I have.

1297. Do you consider it a very fiery mine?—It is considered so generally.

1298. Were you in the neighbourhood in 1826?—Yes.

1299. Do you remember an accident by which 34 lives are reported to have been lost?—Yes, but I do not recollect the particular reasons that were assigned for the accident at that time.

1300. Do you recollect the accident at Dorothea pit, in the May of the same year?—No.

1301. You do not recollect that 38 lives were lost there?—No.

1302. Were you connected with Collingwood Main in 1815?—No; but I went down immediately after I heard of the accident.

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1303. Do you remember any of the circumstances that attended that accident?—I know that the accident happened in consequence of an overman, with deputies and others, having gone down the pit to endeavour to secure the timber and iron, and other materials, that were likely to be lost in consequence of a sudden creep having come on that part of the mine; they were then working with candles, the inflammable gas exploded, and those poor men lost their lives.

1304. Then you infer that that accident occurred in consequence of an eruption of gas attendant upon that creep?—Yes.

1305. Previously to that, are you aware whether the mine was in a highly inflammable state?—No, I believe not.

1306. At that time the safety-lamps had not been introduced?—They had not.

1307. What objections present themselves to your mind to the use of the lamps in every case of mines liable to the eruption of light carburetted hydrogen gas?—The objections, as a matter of opinion, are, that if safety-lamps were to be exclusively employed, the pitmen would be less careful of their lamps, and that it might induce a less vigilant attention to the ventilation of the mines by the overman and the deputies. Now, when candles are partially used in the working of the coal mine, the brattices and doors, and every other means which are applied for the ventilation of the mine, must necessarily be kept in the most perfect and proper state.

1308. You include the stoppings?—Yes. If the lamps were entirely or exclusively used, it might not be thought necessary that the brattices and the doors should be so closely applied, and that the air should be brought up to the extreme of the working places; and if they were not ventilated with the same care, when unfortunately an accident should occur, and explosion take place, the destruction would be very much greater; the mine not being so perfectly ventilated, as it must necessarily be when candles are used, the explosion would therefore in all probability be considerably more violent and the destruction of human life greater when it did so happen.

1309. Then you contemplate a case of fancied security, which would lead the miner to the use of an imperfect lamp; a lamp imperfect in its construction, or out of repair, or negligently used?—No; I mean to say, that the mine would, instead of the hydrogen gas being carried off by the system of ventilation, which is so perfect when candles are used, be less carefully attended to if safety-lamps only were used; the consequence would be, that an accumulation of hydrogen gas might be formed in some of the older and recent workings of the mine, and if an accident did happen, from any of the workmen unfortunately taking off the top of the lamp, or by breaking the wire-gauze, or any other accident which would expose the flame of the lamp to an explosive atmosphere, the effect of that explosion would be more violent and fatal.

1310. That is, that notwithstanding the advantages resulting from the use of the safety-lamp, this would be more than counterbalanced by the increased risk that would be wantonly run into?—I think there would be greater risk incurred in that way, if the enforcement of using safety-lamps only should be determined on.

1311. Have you had any cases, within your own personal notice, of the workmen taking the lamps to pieces under dangerous circumstances?—About six weeks ago I had to discharge two men for having taken off the top of their Davy lamp, contrary to order, in a part of the mine where we were working pillars; fortunately at that time the mine was in a safe state, and no accident did occur.

1312. But for the sake of example you discharged those two men?—I did instantly. I can state an instance in which an accident did happen to two men: I had been informed that a part of the mine was foul, as it is termed, that is to say, there was a considerable quantity of hydrogen gas accumulated in it: I gave these two men directions to go down on a Saturday morning when the pit was off work, and none of the workmen were in the mine; these men were to take their lamps with them and obey the orders which I gave them, and clear that part of the mine of the gas which was there remaining.

1313. You mean by changing the air courses?—Yes, by throwing in a current of air to sweep it off: it was of very limited extent. Immediately the men went through the trap-door into the explosive atmosphere, the man who had the perfect lamp being first, sat down, the other followed him; immediately he passed through the door, the first cried out to him, "What is the matter with your lamp," and instantly there was an explosion.

1314. Will you state what the lamp was, as compared with any of those produced

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duced before the Committee, and numbered?—It was the common lamp of Sir Humphrey Davy, No. 1. The man had thrown his lamp away, and they (the men) were brought to the bank severely burnt. I immediately sent down men to search for this lamp, because I was satisfied that something must have been wrong, or that that accident would not have happened; on an examination of the lamp I found several of the wires were broken, and the man himself confessed that it was in an improper state when he took it there.

1315. Have you any clear recollection of the size of the aperture upon that occasion?—No, I do not recollect exactly; there were three or four of the wires completely broken through.

1316. Do you think that there was more than an extension of two interstices into one?—Yes.

1317. Four?—Yes, more.

1318. Twelve?—No.

1319. The hole was perfectly visible to the naked eye?—Most discernible.

1320. In Willington colliery are there not persons to look after those lamps?—Yes.

1321. That was not one of the men?—No, he was not; he was a man that ought to have known better; he was a wasteman. I am perfectly satisfied that that accident was caused by the imperfect state of the lamp.

1322. You have used the term "wastemen," what is the gradation of workmen?—There are trap-door keepers, boys who attend to the doors to open and shut them to let the workmen pass to and from the working places; these doors are necessary to keep the current of the air to the front of the working places, and thus sweep off the gas which is evolved from the coal. The next class in age and size is the rolley drivers, who are stouter boys, generally about 12 to 14 years of age; those boys are the drivers of the horses which convey the coals from the crane to the bottom of the shaft. There is another class of boys called putters, who are stronger lads, and whose ages vary from 15 to 22 or 23 years; those lads are employed in bringing the corves filled with coal from the hewers working at the face of the bords or the pillar workings to the crane, where they are lifted from the trains and put upon the rolleys which bring them to the bottom of the shaft. The next class is the hewers, who are the producers of the coal. The next gradation in rank is the deputy, who is under the immediate direction of the overman; this man has the management of the pit and the care of the miners in the absence of the overman. The next in station is the overman, who gives the daily directions to the miner as to the working of the mine; he takes an account of their daily earnings, and sees that each working place is properly ventilated before the miner is permitted to go to it; then the under-viewer, whose business it is to descend the mine daily, and see that all is right in the ventilation and general management; he consults with the overmen and gives them such directions as he sees necessary, if nothing occurs of so much moment as to require his previous communication with the viewer; the business of this under-viewer is also daily, or as often as is necessary, to communicate with the viewer, and to take his directions as to what may be necessary for the management of the mine. The viewer is the chief superintendent.

1323. You have not mentioned the wastemen?—The wastemen are not properly employed in the working part of the mine; the number of wastemen is in proportion to the magnitude of the waste they have to look after. Their duty is to see that the stoppings and doors are perfect, and that the openings and air-courses in the waste of the mine afford sufficient facilities for its free and uninterrupted ventilation, and also to remove any obstructions which may have been caused by falls of the roof, or any other accidents.

1324. They are generally chosen as being steady well-conducted men?—They are. Another class is the Davy-lamp keepers, who go down the pits each morning before the hewers and other workmen. They are stationed at a convenient place near the bottom of the shaft, to see that every lamp used by each workman and boy in the pit is in a safe and proper state before he is allowed to proceed with it to his working place; he is supplied with oil and cotton wick, and after a close examination of the lamp, is allowed to go to his work.

1325. Then do the men who use the Davy-lamps deliver them up to this person each night?—After having finished his work, the workman brings his lamp to this man at the bottom of the shaft; he unscrews the bottom part from the gauze, the top part he takes home to clean and keep dry, leaving the bottom with

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the Davy-lamp keeper, who numbers it, and keeps it in a proper place till the next morning.

1326. Then it is the duty of the pitman himself to clean the top of his own lamp?—Yes.

1327. Have you ever known a pitman pick the lock of the lamp?—I am afraid that such things do occur, but I do not know it, except that I discharged those two men before mentioned for having taken off the top of the lamp.

1328. Do you suppose that those men ventured to take their lamp in pieces, knowing that the mine happened to be in a safe state, or that for the same object they would wantonly have acted in like manner under dangerous circumstances?—No; I think they presumed, from the state the lamp was in, that they were safe; but still this being contrary to the orders that were given, it was necessary to make an example of them.

1329. Have you formed in your mind any theory as to the cause of those great explosions that remain still unaccounted for?—I may state generally, that with respect to Sir Humphrey Davy's lamp, I have a perfect confidence in it.

1330. As originally constructed?—As at present constructed.

1331. By that you mean agreeably to pattern No. 1, produced to this Committee?—Yes.

1332. Do you mean to say that a pitman could not force the flame through the gauze to light his pipe?—I will not say that it is not possible, but I cannot, from my own knowledge, state that it is.

1333. Have you any doubt? suppose the lamp lay on its side, and the man tried to force the flame through to his pipe, that he would not succeed?—I think that he would not.

1334. Will you give some information as to the way in which you account for the accidents?—I think when an accident has happened where Sir H. Davy's lamp has been used, the explosion has been caused either by some accident happening to and breaking through the wire-gauze, by the wilful exposure of the flame to the explosive atmosphere, or by the imperfect state of the wire-gauze.

1335. Then you have not, in your own mind, ascribed it to any contingency which might befal the lamp from the sudden and peculiar mode in which the blower acted upon it?—No.

1336. The Committee understand you to say, that unless the lamp is abused you consider it perfectly safe?—I do.

1337. Do you consider the glass any protection?—I think not, though I do not speak from my knowledge of the fact.

1338. Even in the case of the lamp being rapidly passed through an inflammable atmosphere?—If it was passed rapidly through an explosive atmosphere the flame, I think, would be suddenly extinguished.

1339. But might not the flame, in the interim previous to the expiring of the lamp, pass through the gauze?—I think not.

1340. Did you ever see the gauze red-hot in the mine?—Yes, several times.

1341. Have you ever experimented upon the gauze red-hot, agitating it quickly through an explosive atmosphere?—No; violent motion in such an atmosphere is unnecessary, and could not answer any purpose.

1342. Would you venture to swing it round in an explosive atmosphere?—It would appear odd to do so in such a situation; but I repeat I have seen it repeatedly red-hot; certainly it is not a situation that the lamp should be kept in for a lengthened time; it is not prudent.

1343. Is it the general impression of practical men in your employment that the lamp is a perfect protection if it is in a sound state?—It is my opinion.

1344. Is it a general impression?—I can only judge of the general impression from the almost universal use of the lamp.

1345. You heard Mr. Wood's evidence; do not you think that he stated some peculiar cases in which the glass was an advantage?—Yes.

1346. Then, upon the whole, do not you conceive that what he conceives as an improved lamp is a more desirable lamp than that which is in general use?—I think not; considerable doubt is thrown on my mind from the statement made by Sir Humphrey Davy, referred to by Mr. Wood yesterday.

1347. Is that the only reason why you would reject No. 5, as described by Sir Humphrey Davy in his treatise upon this subject?—That is a strong reason, I think, but another is, that in a moderately explosive atmosphere the flame would be very much confined by the glass funnel to the top of the lamp; the orifices of the copper top

top would in a short time be much filled up with soot, and in my opinion it would not afford so good a light as the common lamp of Sir Humphrey Davy.

1348. Have you had an opportunity of proving such to be the result?—No; I only speak my opinion of the merits of the lamp.

1349. Then the Committee is to understand that your experience would lead you to the conviction that any authoritative enforcement of the use of a safety-lamp in mines would be rather injurious to the cause of humanity than advantageous?—I think that the explosions, when they did happen, would be much more serious in the destruction of property, and fatal in the loss of life, than they are at present, if lamps only were used.

1350. Do not you think that it would be very desirable if some means could be discovered of rendering every individual more fully acquainted with the risks attendant upon his occupation?—It is very desirable certainly.

1351. Can you suggest to this Committee any means by which so desirable an object could be simply and easily accomplished?—I cannot at present do so. The common miners take little interest in this matter, which ought so much to concern them.

1352. Not even in their personal safety?—Very little; they place great confidence in the people who are above them; and as to the state of the lamp or of the ventilation of the mine, they do not pay such attention to the subject as might be supposed the danger they are sometimes unavoidably placed in would make them.

1353. Then, in fact, their personal safety depends upon their being duly apprized of their peculiar situation by the parties immediately placed above them?—Except always in such situations as cannot be foreseen by the viewer, the overman or other person immediately placed above them; those exceptions are the sudden irruption of a blower, or the breaking down any stopping, which will check or cut off the ventilation of a part of the mine, and thus cause an accumulation of hydrogen gas, into which inadvertently the candle is introduced, thus causing explosion.

1354. In working mines with candles which are subject to foul air, may not an accident arise from a fall taking place and interrupting the current of atmospheric air, so as to bring the mine in a very short space of time into a most dangerous state?—Not in a very short space of time.

1355. The air current would be still preserved in the same direction?—The air current, if it were destroyed, would be found wanting by the men in the bords, and by the deputies and those who are moving about constantly; they would ascertain there was a want of a proper ventilation of the mine, and would immediately endeavour to discover the cause, and remedy it.

1356. And you can scarcely conceive a case in which they would not be able to reach the shaft before the mine was in a state of ignition?—That would depend upon the quantity of gas that was brought off with the fall.

1357. But you can scarcely suppose a case of its occurring with so much rapidity?—No, I cannot, except in the Bensham seam, where greater quantities of gas have been evolved in shorter periods than in any other seam of coals with which I am acquainted.

1358. Do you remember an accident at Walker's colliery, in the year 1823, from the falling of the earth, by which it is reported that six men lost their lives?—Yes.

1359. Do you remember any of the circumstances?—The men were employed in clearing away the rubbish from an old shaft; the shaft was filled a depth of about 80 fathoms; the workmen commenced at the bottom, and in the course of their operations an immense quantity of stones, &c. came down and killed the men that were working.

1360. Which could scarcely be considered as having taken place in the body of the mine?—No, it could not.

1361. Do you recollect an inundation that took place in Heaton mine in 1815, by which it is reported that 75 men lost their lives?—Yes.

1362. Do you think any reasonable precautions would have prevented that terrible calamity?—I was not the viewer of the colliery at that time, and I presume that the gentleman who had the direction had taken every precaution that his experience would suggest to him, and the peculiarity of the situation required.

1363. Did not that probably arise from imperfect mapping of previous workings?—The plans of the old works of mines are not generally perfect; but in proceeding in any direction where there is a doubt, or indeed whether there is doubt or not, the viewer directs exploring drifts to proceed for a certain distance in advance of the main body of the workings, and if a worked-out mine lies in that direction,

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holes are made in those drifts to ascertain the old waste, and thus prevent any accident occurring by coming suddenly on it.

1364. By which it is intended that the water should be received gradually also?—Yes.

1365. When you described the accident which took place in the Willington colliery, you have said that it was a rush of fire-damp from the Bensham seam; had the Bensham seam been worked at that time?—Not to any extent.

1366. What seam were you working?—The High-main seam.

1367. Is there not some coal found in the Willington colliery of the same nature as the cannel coal?—Yes, it is a splint coal.

1368. Do you observe that there is any difference in the liability to the escape of gas from coal of that quality?—Splint coal contains considerably less bitumen than the other coal of the mine, and gives out less gas.

1369. In the enumeration that you gave of the different descriptions of persons employed in the mine, you mentioned the child that guarded the trap-door; what is your opinion of the competency of those children to discharge their duties; are they sufficiently attentive?—Their conduct is similar to others of that age, and requires that they should be compelled continually to do that which they would neglect otherwise; but from the number of parties who are constantly passing through those doors in all directions, I consider that they are generally very attentive to their duty.

1370. Have you reason to apprehend that mischief has arisen from the neglect of those children in the parts of the mine where they are situate?—Occasionally there has.

1371. Should you think that that neglect has arisen more frequently from the employment of those children than if men had been employed to perform those duties?—I think many of the serious accidents that have happened from the neglect of the trap-doors have been caused by leaving a door open after the men had given over work, and the boys had left their doors. The ventilation of a part of the workings being thus interrupted for some hours, in the morning, when the overman or deputy has come into that part of the mine, being unaware of the danger, explosions have happened in that way more frequently than from the neglect of any door during the time that the pits have been working.

1372. Is there any person in the mine whose duty it is to see, when the men quit work, that the mine is left in a proper condition as to trap-doors and other matters?—It is the duty of the back overman or deputy to see that all the trap-doors, brattices, &c. that are necessary for the proper ventilation of the mine, are placed in a state necessary to maintain it during the course of the night, before he leaves the pit.

1373. Then when those accidents have happened that you have last alluded to, it has been more from the fault of the person that ought to have attended to that matter than from the carelessness of the children?—It is so.

1374. Have you frequent accidents from the raising and lowering the men to their work?—No.

1375. Have you accidents from any other cause than those which you have mentioned?—Yes; occasionally from the roof of the mine falling down, or from the coal falling unexpectedly and crushing the men.

1376. Is that of frequent occurrence?—It is of frequent occurrence, but not always to the loss of life; to the fracture of limbs very often.

1377. Does that arise for want of precaution?—Very often it is unavoidable, or rather, when every precaution is taken, the stone breaks off unexpectedly, and falls down on the men before they can get out of the way.

1378. Does it often happen from want of proper observation in the men who have to overlook the work?—The stone, where there is danger, is always secured and supported by props and timber.

1379. So far as your experience serves, is the health of the pitmen engaged in fiery mines injured by being exposed to such an atmosphere?—I think it is not; I have never observed any difference in the appearance of the pitmen, whether employed in a fiery mine, or to the contrary.

1380. Have you never drawn any comparison favourable to mines free from damp?—No.

1381. As you are fully aware of the nature and objects of this investigation, have you any suggestions to make to this Committee which you think might lessen the risk attendant upon mining occupation in all its various branches?—I think the tendency

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tendency of this investigation will be to cause scientific men to make further researches, to endeavour if possible by their skill to avert danger, and to make the system of mining more perfect and more complete than it is.

1382. Can you add, from your own experience, anything new to what has been already detailed in your presence, or by yourself?—No, I think not.

1383. Do you think it would be desirable that scientific men should be induced to visit the collieries, and to inspect the mines, and make experiments upon the spot?—I think they would have a much better opportunity of doing so satisfactorily at the mines than they can otherwise have. Many scientific gentlemen, who are perfectly qualified otherwise, are not perhaps aware of the difficulties that present themselves in the under-ground workings of an extensive colliery: the division of the colliery into districts, the many intricacies, and the numerous passages that are in a mine, are among those difficulties. An investigation by scientific men in the coal district would therefore be of much more value and importance than it can possibly be in a distant place, or at their own homes.

1384. Do not you think that such a statement of facts as may appear on the Minutes of Evidence given before this Committee will tend to direct the minds of scientific men more correctly and more directly to the objects sought to be attained?—I think it will have very much that tendency.

1385. Have there not been considerable exertions made at the instance of Mr. Brandling, the coal proprietor, aided by gentlemen mostly connected with the collieries, to obtain a complete map of the mineral districts of the Tyne and Wear?—Yes.

1386. If they should succeed in obtaining materials for a map of that nature, would it, in your judgment, be very beneficial as a preventive of future accidents?—It certainly would be so, in a degree; but the boundaries of all the coal fields in Northumberland are now so well ascertained, it is not probable that any accident can or may happen from a want of knowledge in the viewers of the precise distance to which each party may proceed in working his own royalty; but a general map of that kind, to be referred to, would be useful to the trade generally.

1387. Has the reason why that work has not proceeded much hitherto been because they are not able to get a good surface map to refer their plans to?—I think it is more from the wish of gentlemen not to discover the exact extent of coal which has been excavated in their own mines.

1388. Are you aware whether there was an application made, some short time back, to Government, to expedite the publication of the Ordnance survey for the completion of such a map?—So I have heard.

1389. Do you think it would be desirable that Government should give directions for that survey?—I think so.

1390. Do accidents very frequently occur from unexpected communications with old works?—Not very frequently; when the extent of the old workings is doubtful, great precaution is taken, by drifting and boring, in approaching them.

1391. But it is very important that proper maps should be kept?—Yes, it is.

George Fife, Esq. M. D., called in; and Examined.

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1392. ARE you doctor of medicine, residing in Newcastle?—Yes.

1393. Are you also one of the coroners of that district?—I was the previous year.

1394. You have been also lecturer on medical jurisprudence in the school of medicine and surgery in Newcastle?—I have.

1395. Have you had any opportunity in the course of your professional pursuits of observing the relative state of health enjoyed by the labouring mining population, as compared with the population who surround it?—Some years ago I attended professionally at several of those collieries, not only on those who suffered by accident, but also those who suffered from disease; and in certain situations the health was not certainly, on the average, so good as the health of persons following other pursuits; but I observed invariably that the health of the miners seemed to be affected most by the relative degree of heat and moisture in the workings; men in those workings which are very moist and hot we generally find have an impaired state of health.

1396. Then the Committee understand your remark to apply more to the temperature of the atmosphere in which the men are employed than to any combinations of noxious gas, or to the habitual use of wet clothing?—I conceive that all

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those causes must, to a certain extent, operate on the system of persons employed in coal mines, but I would ascribe most injury to extreme variations in temperature and the degree of moisture.

1397. Do you consider, from the necessary ventilation of the mine, that the men are exposed to the action of the drafts of air, or the currents of air, in a way prejudicial to their health?—I should think it must in many situations be decidedly prejudicial, because we must suppose a person working with some degree of violence to be liable to suffer a good deal from over-heat, and consequently, to be frequently almost bathed with perspiration, the sudden suppression of which we know to be most deleterious to health.

1398. Have you ever observed upon the degrees of temperature in different mines?—No; I should observe, that I was never myself in the workings of a coal mine.

1399. Will you give the Committee a general idea of the nature of the accidents most frequently occurring which have come under your notice?—The principal accidents which I have observed during my attendance on accidents have been from burns, and from fallings of portions of the roof of the working, and occasionally also from other causes, which are altogether, perhaps, accidental, and might occur in other situations.

1400. Have any of those accidents from burning been to any considerable extent?—I remember on one occasion there were several men burnt at Killingworth colliery; it was in the year 1823; I think some of those men, if my memory does not deceive me, died at that time; the majority of them recovered; Mr. Wood, who is the agent to the colliery, can give much more correct data upon the point than I can.

1401. Were those burns such as permanently to cripple those that were injured?—I do not remember; I only assisted in the colliery one year, and therefore did not make that minute observation of the consequences which I otherwise might have done.

1402. Have you met with many cases in which the sinews and the tendons were so much affected as to incapacitate the men from the future pursuit of their employments?—Several; but I conceive that in the majority of those cases the injury is very much to be ascribed to carelessness on the part of the medical or surgical attendant; I do not mean to say that this is universally applicable, but in very many cases I have seen such effects after injury by burning, where I think judicious medical and surgical treatment would have obviated such an effect.

1403. Without going into particulars, do you attribute such cases to the absolute want of skill on the part of the attendants, or to a positive neglect of the case?—It may arise in either way.

1404. Have you been led to ascribe it more generally to one cause than to the other?—I conceive that a person who does not watch such a case as I have alluded to, for example, when the hands and the fingers are much burnt, may find, in consequence of not being very particular in the management of those fingers, that the fingers are adhering together, in consequence of the raw surfaces being in immediate contact; in fact, the fingers become in a manner webbed.

1405. Such cases have come under your personal observation?—I have seen the remains of such cases.

1406. Are you aware of the practice which obtains in those collieries, of owners providing what they deem sufficient surgical or medical treatment in case of accident?—I believe that the owners do universally supply to the collieries what they conceive to be competent medical attendance; I am not aware of an exception at this moment.

1407. Does that consist simply of directions to the men to place themselves under the care of some particular medical gentleman, or is there a contract for a medical and surgical attendant required for any certain number of men?—In some cases medical gentlemen take those collieries under a contract, at so much per annum, for attending the colliery; in other cases, I believe, medical gentlemen have bills. I know that both practices do exist, but I know that in the case of every accident requiring immediate attention, a servant of the colliery is invariably sent for a medical attendant so appointed by the owners.

1408. Does a system of public competition amongst the medical and surgical practitioners take place in such cases?—Not that I am aware of; I believe that applications are made by individuals to owners, but I am not aware of any actually recognised

recognised competition existing in such cases; we find that the owners in many cases appoint their own professional attendant.

1409. Would you or not consider such a practice of competition, if it generally prevailed, liable to very considerable abuse?—Most decidedly; and I consider that we have that illustrated in the management of the funds under the new system of the Poor Laws.

1410. That the temptation is almost too strong to put off the patient with a less portion of time and attention, and with medicines objectionable in quantity and quality?—I do not mean to say that; but I conceive where a sort of competition is kept up which depends upon the remuneration to be offered, that we find frequently evil consequences do arise from the man of inferior attainments succeeding in obtaining such appointments. This is not the case, to my knowledge, with the collieries in the neighbourhood of Newcastle; I am not aware of any surgeon being connected with one of those collieries who is not a man of education and competent for his duties.

1411. Has anything suggested itself to you as a prevailing practice in the district injurious to the general health of the miners which might be readily obviated on the part of the masters or viewers?—I have not made any observation that could lead me to suggest anything on that subject.

1412. Do you know whether the men leaving work in their wet clothes frequently proceed to considerable distances before they reach their homes?—I believe, as was stated in evidence two days ago, that some of the miners live at considerable distances from the pit in which they work, and consequently have to go a great way home previous to making that change.

1413. As a medical man, do not you consider that if means were provided for changing their dresses on leaving work, those dresses being provided by themselves, it would be a valuable precaution to the health of a miner?—I believe that would require some consideration; for this reason, that if the man changes his clothes, he generally at the same time cleans himself; and now, if we suppose a worker coming out of the shaft of a pit in a profuse perspiration, and then proceeding to change his dress and clean himself, I should think that perhaps evil might arise from it. We are to remember that the man in proceeding home is in a state of exercise, and that perhaps of a comparatively moderate nature, so that he cools gradually, instead of going from the extremes at once.

1414. Have you taken into account the facilities which exist in all collieries of any extent to provide a sufficient quantity of warm water and warm apartments, while he is undergoing the necessary washing and change of clothes?—I know that it might be carried into effect, but I believe the greatest obstacle would be with the workmen themselves.

1415. Are you aware that such a practice universally prevails in some parts of Cornwall?—I am not aware of it.

1416. Would you doubt the experience of individuals who should state their opinion that it had been decidedly advantageous on the whole?—Not at all; decidedly not.

1417. Do you consider the miners engaged in coal works peculiarly subject to complaints of the eye?—No; I have not observed it. I consider that many other artisans and labourers are infinitely more so than the pitmen.

1418. In the case of persons suffering from accidents, have you observed any unwillingness in them to return to their work, or are they generally very eager to go to the pits again?—I think they generally return to work so soon as permitted by the surgeon to do so. I have never observed any particular repugnance on the part of miners to their work.

1419. Is not it the case that the dirtiness of their employment requires a greater attention to cleanliness than is required by other working people?—I should say, taking pitmen generally, that they are cleanly in their habits.

1420. Taking, together with that personal cleanliness, the advantages that they have of a warm habitation and abundance of fuel, do you think that their employment is healthy or otherwise?—I have not observed more disease amongst miners than amongst other persons.

1421. They are not able effectually to clean themselves more than once a week, are they?—Yes, every day.

1422. Do not they wash their persons every day?—One of the first things that the pitman does on coming home is to wash himself all over with warm water.

1423. Is it not a rare circumstance to see a pitman in his working dress or

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with his black face at six or seven o'clock in the evening?—I never saw it during the time I attended Killingworth colliery.

1424. Their appearance is remarkably clean, is it not?—Exceedingly so.

1425. To what average length of life do they attain?—I have not calculated that; I would not say that they are more healthy than others, but I do not consider them peculiarly prone to disease.

1426. Are you aware whether the statistical tables published do show equal longevity by those pitmen with persons engaged in other pursuits?—I have not seen those tables. I ought to mention that it is in consequence of the hurried manner in which I left Newcastle that I did not make any sort of preparation for this examination.

1427. Can you speak at all with respect to the late accident which has occurred?—No; I left on Saturday; the accident occurred on the Thursday. I was at Wallsend on Friday evening, the 19th, to make inquiries relative to the accident.

1428. Were you present when any of the bodies were recovered?—Not when they were recovered; I saw several of the bodies which had been recovered; at that time there were only 21 brought up the shaft.

1429. Were you present at the examination of any of the bodies?—I examined externally several of the bodies, and was present at an anatomical examination of one.

1430. Did it appear, from what you have observed, that they had died from the suffocation of the choke-damp, or from the fire-damp?—From suffocation, occasioned by the choke-damp. From the internal appearances of one of the bodies, I am inclined to believe that the death had been gradual, and not sudden.

1431. Were any of them opened to discover the effect of that damp internally?—Mr. M'Intyre, the surgeon to the colliery, asked me to be present with him at the examination of one body.

1432. Can you state to the Committee the appearance of any body so examined?—I examined several of those bodies externally, and in none of them saw appearances which would lead me to suppose that they had been burnt to death. Some of those bodies showed marks of burning, also of bruises, so that it would be difficult in such cases to determine whether death had been the result of concussion or of the fire.

1433. But some you examined internally?—One only. With regard to the internal appearances of the body that I inspected, which was an adult, we had all those appearances which would be produced by exposure to carbonic acid gas, or rather by the inhalation of that gas, because we know that death may be produced by the mere mechanical deprivation of atmospheric air, or it may be produced by the inhalation of the gas, which acts as a poison.

1434. Do you consider that the body which you examined had died from the effect of the gas so inhaled?—Inhaled for some time, operating as a poison. I should state that we were prevented from opening the head, so that the examination was not so perfect as was desirable; but from the appearance of the lungs, great vessels and the heart, no doubt can exist as to the cause of death, and the manner in which it had been produced.

1435. There was no appearance of scorching internally?—None whatever; the skin was not broken in any part of the body which we examined.

1436. In what interval do you think, from what you have observed, that death had taken place in those cases?—It might be a few minutes in this case; and I may state, that the opinion which I expressed upon the spot at the time, before I was aware of the fact which I am now going to mention, is, that this man was found a short distance from the place where he had been working; that it was supposed afterwards by persons who found him that he must actually have removed himself from the place where he had been at work.

1437. Are you aware of the fact that he was found in a recumbent position?—I am not aware of those particulars.

1438. The choke-damp is of heavier specific gravity than the atmospheric air?—Yes.

1439. Then if they had unfortunately been crawling along to make their way out of the mine, they would have been travelling in the most noxious atmosphere, would they not?—No, the air would be diluted; in those situations we generally find that the relative position of gaseous bodies is, to a certain extent, altered by the currents.

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1440. With regard to the appearances of the other sufferers; were they those of much physical agony?—No, they were not; the countenances were generally placid and composed.

1441. Were any of their limbs in a shattered state?—I did not observe any; I merely looked at them with a view of ascertaining whether the signs of being burnt to death, or of suffocation, predominated.

1442. Do you not think, that those being the bodies first obtained, were nearest the shaft, and therefore were not liable to such great concussion as some of those nearest the point of explosion?—Of course if they were farther from the point of explosion the concussion would be less.

1443. Do not you think that such was the fact?—I think so.

1444. Will you state to the Committee your idea of the distinct character of the noxious gases that must be met with in the coal mines?—I should think the noxious gases, at least those exerting any decided effect upon the system, would be the carburetted hydrogen, of which there are two species, heavy and light.

1445. What distinction do you draw between the two?—The one contains a larger proportion of carbon than the other. We have also the carbonic acid gas, which is the result of the decomposition by fire of the former; the carbonic acid gas being the most deleterious to health when respired.

1446. But may not carbonic acid gas exist without the possible presence of fire, or the known agency of fire?—It may; it has been known to do so; I do not know that it has in coal mines, but there are situations, I believe the Grotto del Cane, and other situations, where it is met with.

1447. But you have never heard anything to induce you to believe that it is in considerable quantities in coal mines?—No.

1448. Were you present when Mr. Wood alluded to the presence of sulphuretted hydrogen in collieries?—No, I was not; but I can believe that possible, because we know that sulphur exists extensively in nature.

1449. What would be the process by which the vital functions would become extinct owing to the presence in large quantities of sulphuretted hydrogen?—In all those cases death is produced in consequence of the deoxidation of the blood.

1450. What will be the first sensible impression of pain?—Difficulty of breathing would be the first, perhaps after that giddiness and fainting.

1451. Do you think that the sensorium would be affected?—In many cases by the carbonic acid gas the effects produced, both upon the organs of respiration and the sensorium, appear to be instantaneous.

1452. Supposing a bore-hole of two inches in diameter, immediately communicating with a magazine of sulphuretted hydrogen, and a party tapping that magazine through the bore-hole, would you conceive it possible that he should be so instantly overpowered with it, as to be unable to remove himself from the place where he first felt the consequences which you have hinted at?—Not if the situation in which he was was well ventilated. If there was a space for free ventilation I think the gradual introduction of sulphuretted hydrogen in that way would not produce an instantaneous effect.

1453. But supposing him to be surrounded by a calm and still atmosphere, even of an unobjectionable nature, in a confined chamber?—I think the effect would be very speedily produced.

1454. In the course of your chemical researches, has anything suggested itself to you by way of decomposition or neutralization of carburetted hydrogen, to the extent to which it is found in the mines?—It has not. I have attended to the subject only so far as relates to medico-legal investigations; I have heard many theories and speculations upon the question which I am now asked, but not one of which I should be inclined to reiterate.

1455. Do you despond, as a scientific man, of the introduction of any foreign agency by which the noxious effects of carburetted hydrogen might be entirely obviated?—I do not conceive that I have at present given sufficient attention to the subject, but I should be apprehensive that no chemical process would be effectual.

1456. Then you would rely altogether upon complete ventilation?—Yes, and the safety-lamp.

1457. Have you ever made any experiments upon the lamp known as Sir Humphrey Davy's lamp?—Not upon the lamp, but I have both made, and seen experiments made, with the gauze of which that lamp is constructed, with inflammable gases.

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1458. Have those experiments tended to strengthen your conviction of the value of that lamp as a protection to the miner, or otherwise?—To confirm my conviction of the utility of that lamp.

1459. Have you had an opportunity of seeing the improvements upon that lamp which have been suggested to the Committee?—I have not, nor do I conceive myself altogether competent to appreciate them; but I conceive that the principle upon which Sir Humphrey Davy's lamp is constructed is both simple and effectual.

1460. What do you understand to be the rationale of Sir Humphrey Davy's lamp?—The impermeability of the gauze to flame, and its permeability to air.

1461. And you would have no hesitation in trusting yourself with that lamp in any admixture of carburetted hydrogen and atmospheric air which you are able to contemplate?—I would not.

1462. And to make a rapid motion through that atmosphere?—That requires some consideration, in consequence, at least, of a statement made to me by an honourable Member of this Committee, that a recent experiment had been made which proved that the gauze was not then so safe; but I believe that such currents of the velocity mentioned will rarely be met with, if ever, in a coal mine.

1463. Do you agree in the mixture of one-eighth of carburetted hydrogen with atmospheric air being about the most explosive mixture that can be produced?—Of pure carburetted hydrogen that is the most explosive admixture; but of the fire-damp in coal mines which are impure, I believe it may be calculated from eight to ten.

1464. Have you ever observed the effects of those combinations of gases upon the wire-gauze?—I have not, but have tested their relative inflammability.

1465. Have you any reasons to suppose that the indications by the barometer would be striking or obvious?—I have not made any observations on that point.

1466. You have never been in a mine, and therefore are not able to state whether the barometer would indicate any decided changes, as the proportions vary?—No.

1467. How long did you hold the situation of coroner?—For one year; the appointment is for one year.

1468. Were any cases of sudden and fatal explosion brought under your notice officially?—One case occurred of an inquest, which my colleague conducted in consequence of my being engaged in another inquest: it was a case which occurred at St. Lawrence colliery.

1469. Was that in November 1833?—I do not recollect the date.

1470. Was that the case in which three men are reported to have lost their lives?—Either three or two.

1471. Did the circumstances connected with that inquisition come under your notice?—I heard of it after the inquisition, and it appeared that the explosion took place whilst the persons involved in it were building a wall, or some stoppage.

1472. Do you remember whether the safety-lamp was in use in that mine?—I was informed that these men had candles; I believe the safety-lamp was in general use, but that those men (masons) had candles; they were not pitmen, I believe.

1473. Do you know whether that is considered a very dangerous mine?—I am not aware of it.

1474. Then you do not recollect whether any neglect on the part of the viewers, managers or overmen can be attributed in that case?—I should conceive not from the verdict of the coroner's inquest, which was accidental death, I believe. I do not know that there was any deodand given in the case.

1475. Is it common to give deodands in the case of accidents in mines?—Not to any extent, except where wilful neglect is attached.

1476. What is the largest amount of deodand imposed?—I do not remember.

1477. Do you remember any sum so high as 20*l.*?—I do not.

1478. You are perfectly aware of the nature and objects of this inquiry; does anything suggest itself to you, not only as a medical man, but as a gentleman of scientific research, and a resident in this immediate district, by which the objects of this inquiry may be furthered, to the advantage of mining, or the comfort of the miner?—I should think, if practicable, one of the most important steps for this Committee to adopt would be to insist upon the universal employment either of the present or of some other equally safe lamp.

1479. Have you heard the evidence of witnesses who have been examined by this

this Committee as to the degree of general carelessness which they apprehend will be engendered by the constant use of that lamp in cases where no care is requisite?—I have, but I do not consider that objection valid; for this reason, that carburetted hydrogen being a spontaneous production of the mine, of which we possess no definite knowledge whatever as to when we are to expect to meet with it, I conceive that we ought to be prepared, if possible, to meet the danger when it does occur; and I believe also that, with proper superintendence, the miners might be compelled to attend to and take care of their lamps. I would also make one suggestion with regard to the keepers of the traps in mines where those trap-doors still exist for the purpose of ventilation, and that is, that a minimum age ought to be fixed at which persons should been trusted with such duties, because, whether we regard the physical or the mental capacities of the children, I am quite satisfied that they ought not to be at so early an age, as has been the case, entrusted with any charge on which the safety of the mine so essentially depends.

1480. The Committee have heard that no child is employed under 10 years of age; should you think at that time of life they are fit for those duties?—I should not like to trust to them if I was in one of the workings.

1481. What is the minimum that you would suggest?—From 12 to 13 is the lowest age.

1482. Whilst you admit that there may be that precocity in a child to make him fit for the duty at an earlier age, you think that the general rule ought to be made absolute?—As an average, I should say 12 years should be the lowest.

1483. Does anything further suggest itself to you as to the general diffusion of information, connected as you are with the scientific and popular institutions in that district?—I think the miners ought to be instructed as to the use of the lamps, and I cannot see that it would be very difficult, with a little trouble, to make every miner understand the cause of his safety in dangerous situations; and I believe that if proper measures were adopted every miner would very soon be both competent and ready to take care of his lamp.

1484. Are the miners able to read?—I believe that many of them are; I am not prepared to say what proportion.

1485. A large proportion?—I am not prepared to say even that.

1486. Do you doubt the miners being ready to assemble, on any given occasion, to receive from the head viewer, or other person in authority, a clear and explicit explanation annually of the dangers and duties of their employments?—I believe that the miners might be brought together in such a manner; it is my opinion.

1487. Do you not conceive that such a plan, regularly pursued, would have a decidedly favourable effect in turning their attention to those circumstances?—I think it would.

1488. (To Mr. *Johnson*.)—In the case of any widows of miners being left in consequence of fatal accidents in the mines, do they quit the colliery village, or what provision is made in their favour by the proprietors?—The widows have occasionally been made a weekly allowance in money for a considerable period, and invariably they are allowed to remain in their houses as long as they live; they are provided with a good house, which is kept in repair, and supplied with an abundance of fire coal.

1489. And that you say is the universal practice?—In every place that I know of. As to the pitmen being able to read, I believe that a very large proportion, at least in my neighbourhood, are well able to read; and the rising generation, I would say almost without exception, are taught to read.

1490. Have they clubs amongst themselves, in case of sickness or accident?—They have clubs, which are very well supported. In case any accident happening to a workman, while employed in the mine, and which renders him incapable of following his employment, he is allowed 5*s*. a week by the owners of the colliery so long as he is incapable of working; and I have known this allowance continued for a period of 12, 15 or 18 months.

1491. (To Mr. *Wood*.)—Have you, in the course of your experience, drawn any conclusion unfavourable to fiery mines, as prejudicial to the health of the workmen employed in them, as compared with those in which fire-damp does not prevail?—I think not, judging from the clubs that they have amongst them for supporting each other in cases of sickness: there are separate funds for the men employed underground and those who are employed at the bank, and I believe the payments in both those cases are the same.

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1492. Then if you were to hear it publicly stated that the introduction of the safety-lamp, as inducing owners to employ their men in foul mines, has been a great evil, you will be inclined, from your own experience, to doubt the correctness of such an assertion?—I think, if all the men of the district were employed in mines that were foul, and in a bad state, perhaps it might have some effect; but the great majority of mines, as they are worked at present, are not in that state, and the mines to which I allude are certainly not in that state.

1493. Have you ever heard of such an assertion made as the one to which allusion has been made in the question?—I think not.

Veneris, 26° die Junii, 1835.

JOSEPH PEASE, ESQUIRE, IN THE CHAIR.

George Stephenson, Esq., called in; and Examined.

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1494. YOU are a Civil Engineer?—I am.

1495. Formerly resident in the north of England, and now residing in Leicestershire?—Just so.

1496. In your capacity as a civil engineer have you not been engaged either as directing or consulting engineer on most of the principal railroads executed or in progress of execution in this kingdom?—I have.

1497. Have you also been employed in that capacity abroad?—I have.

1498. In consequence of those engagements, have you obtained a general knowledge of the mining districts of this kingdom?—I have. Previously to becoming a civil engineer, I was very much engaged in the mines in erecting steam-engines underground, and inclined planes for bringing the coals from the mines to the mouth of the shafts.

1499. In the course of your professional engagements as an engineer, have you taken the opportunity of visiting the mining districts through which these public works have been conducted?—I did some years ago; I have not been so much engaged in it lately, except in some colliery works belonging to myself and partners.

1500. Your outset in life was not in very flattering prospects, and different from the engagements in which you have since been occupied?—It was not. I worked at the steam-engines for many years, took charge of them, kept them in repair, and attended to the work myself.

1501. As connected with the mechanical part of the concern in which you were engaged, did your engagements ever lead you underground?—They did. After making some improvements in the steam-engines aboveground, I was then requested by the manager of the colliery to go underground along with the manager, to see if any improvements could be made in the mines by employing machinery to bring coals out of the deep workings of the mine.

1502. You allude to the substitution of machinery for manual labour and horses?—I do.

1503. Was that change effected to a considerable extent, and with what degree of success?—In my first going down the Killingworth Pit, there was a steam-engine underground for the purpose of drawing water from a pit that was sunk at some distance from the first shaft. The Killingworth coal field is considerably dislocated. After the colliery was opened, at a very short distance from the shafts, they met with one of those dislocations, or dykes as they are called. The coal was thrown down I think about 40 yards. Considerable time was spent in sinking another pit; I forget the distance now from the main shaft; but the pit was sunk to the depth I allude to. This engine had been erected some time previous to my going down the pits. On my being down the pit, I proposed making that same engine draw the coals up an inclined plane that descended immediately from that place.

1504. Can you give a general idea of the extent to which manual labour and the use of horses also was reduced?—I cannot tell exactly, but I can tell the number of horses that we had in one of the pits: at one time I think it was 100 horses. A considerable change was made in the colliery, not only in applying machinery, but in applying putters instead of horses, in bringing the coals from the hewers (as they are called), which by the machinery introduced into the mines, and by that change of putters, the number of horses was reduced to 15 or 16.

1505. Did

1505. Did the time occupied in making these important alterations give you an opportunity of observing the mode in which mining operations were conducted in that colliery?—It did. I went round the workings with the viewer almost every time that he went into the mine, not only at Killingworth, but he took me to all the collieries he was engaged with, Mountmoor was one, Derwentcrook, Southmoor, and those different collieries belonged to Lord Ravensworth and partners, and the whole of the machinery in all these collieries was put under my charge.

1506. You are alluding to the mines belonging to my Lord Ravensworth and partners, and the Killingworth?—I am.

1507. Were those mines considered, and are they still considered, fiery mines?—The Killingworth particularly so: in Mountmoor there is certainly a considerable quantity of gas occasionally thrown out, but nothing like Killingworth, at least at that time.

1508. At what time did this general opportunity of inspection to which you have alluded occur?—I do not recollect now, but I should think it must have been 20 years ago.

1509. Was it not previous to the year 1815?—Perhaps it might be, I do not recollect; I was employed in mines many years before 1815.

1510. Were you at Killingworth in the year 1809, when it is stated that an explosion took place by which 12 lives were lost?—That was before the time that I was employed underground.

1511. Were you in the neighbourhood?—I was in the place at the time; there were two explosions, and I think it would be nine or ten in the first explosion, and twelve in the next.

1512. Do you recollect a previous explosion in 1806?—I recollect the first explosion that took place in the colliery, for I was there before the coal was sunk to—

1513. When 10 men are reported to have lost their lives?—Yes, I was at the top of the pit when the explosion took place.

1514. Will you describe the appearances at the time that you were present at that explosion in 1806?—The pit had just ceased drawing coals, and nearly all the men had got out; it was some time in the afternoon, a little after midday; there were five men that went down the pit, four of them for the purpose of preparing a place for the furnace, the fifth was a person that went down to set them to work; this man had just got down to the bottom of the shaft about two or three minutes when the explosion took place; I sent the man down myself. I had left the mouth of the pit, and gone about 50 or 60 yards away, when I heard a tremendous noise, looked round, and saw the discharge come out of the pit mouth like the discharge of a cannon; it continued to blow I think for a quarter of an hour, discharging everything that had come into the current; there was wood came up, stones came up, and trusses of hay, that went up into the air like balloons; those trusses had been sent down during the day, and I think the trusses had in some measure injured the ventilation. The ground all round the top of the pit was in a trembling state; I went as near as I durst go, and everything appeared cracking and rending about me; part of the brattice, which was very strong, was blown away at the bottom of the pits; very large pumps were lifted from their places, so that the engine could not work. The pit was divided into four by partitions; it was a large pit 14 feet diameter, and partitions put down at right angles which formed four. The explosion took place in one of those four quarters, but it broke through into all the others at the bottom, and the brattice or partition were set on fire at the first explosion. After it had continued to blow for a quarter of an hour, as I have stated, the discharge ceased, and the atmosphere all round poured into the pit to fill up the vacant place that must have been formerly occupied by the flame. In one of the other pits, that was connected with this one in which the explosion took place by some doors in a drift leading from one pit to the other, several men, who were in the adjoining pit, were not reached by the explosion, and several of them got up safe. The ropes in the first shaft were shattered to pieces by the force of the blasts, but the ropes in the other pits were still left uninjured, at least they were very little injured. Nobody durst go near the shafts, for fear of another explosion taking place, for some time, at last we considered it necessary to run the rope backwards and forwards, and give the miners, if there were any at the bottom of the shaft, an opportunity of catching the rope as it came to the bottom; whenever the rope went to the bottom it was allowed to remain a short time till we considered they had time to cling to it; several men were got up in this way; and another man

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had got hold of the rope, and was drawn away, when an explosion took place at the time he was in the shaft, but it was merely like the discharge of a gun, and it did not continue like the former blast. This man it appeared had been helped up so far with the increased current that came about him, and the rope running up at a great velocity, the man came up without being injured; it was a singular case.

1515. Then were the five men of whom you have spoken, and whom you apprehended had just reached the bottom of the shaft when the explosion happened, saved in the way you have mentioned?—No; the four out of the five were not seen again for three or four and twenty weeks; they were buried among the corves or baskets, and little carriages, at the bottom of the shafts, and not seen till that time

1516. Did the sides of the pit fall in?—No, they were obliged to fill it up with water, to put out the fire. The overlooker that went to set those men to work knew the situation that they were likely to be placed in, and hearing the noise before it reached the shaft, he threw himself behind some pillars near the pits, so that the current went past him; the flame came about him, and nearly all his clothes were burnt off his back, though he laid down I believe with his face downwards so as to save the part that was not covered with clothes. After the blast ceased, this person got up and found his way round to the other pit; he knew that there was no chance of getting up there, and he was one of the persons that came up in the way I stated; several others came up in the same manner. The pit continued to blast every two or three hours, for I think two days.

1517. It continued exploding?—Yes. It appears that the coal had taken fire, and as soon as the carburetted hydrogen gas collected in sufficient quantity to reach the part where it was burning, it ignited again; but none of the explosions were equal to the first, on account of many parts of the mine having been filled with azotic gas, or the after-damp of the mine.

1518. What lapse of time took place before any of the viewers or managers of the colliery were able to explore the extent of the damage occasioned by this explosion?—It was 23 or 24 weeks before they got to the bottom of the shaft, which was so shattered that it required to be repaired, and the atmospheric air to be carried down.

1519. Were there no means of access from any of the other shafts?—There were none; the other shafts became in the same state very soon.

1520. Then the bodies of the sufferers were not recovered for the space of time that you have named?—They were not. All the ditches in the "country-side" were stopped to get water to pour into the pit. We had extinguishing or fire engines brought from Newcastle, and the water was poured in till it came above the fire, and then it was extinguished.

1521. This accident was of course attended with severe pecuniary loss to the owners of that colliery, in addition to the destruction of human life?—It was.

1522. Have you formed any estimate of the damage, independent of the cessation of working, which resulted to the proprietors from this terrible accident?—No, I had no means of doing so; I should consider that it must have been many thousand pounds.

1523. Would you consider it an excessive estimate to have supposed that damage to equal 10,000*l.*, independent of the loss of life?—I should think more.

1524. Twenty thousand pounds?—I should think more than that; but I cannot say; I should think that very likely it might be 20,000*l.*; but I dare say it will be shown by the books.

1525. But you are understood to speak with reference to the extent of damage, and the consequent repairs, over and above any loss which might be sustained from the impeding of the work?—I could not give an estimate as to the damage done without some time to consider it.

1526. Then you are understood to speak in your apprehension of a total loss sustained by the owners in consequence?—Yes.

1527. You have detailed the circumstances of the explosion of 1806: can you give any of the circumstances of the explosion in 1809?—I was at the pit when that took place, but it did not reach the shaft.

1528. Was the extent of damage equal to what was sustained on the former occasion?—Not to the coal-owners, but more loss of life; I think 12 were lost at that time, and, I think, principally by the after-damp.

1529. Had those accidents any effect in turning your attention to the nature and causes of those accidents?—I was not in the mine at that time; but as soon as I went

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I went down, I was frequently erecting machinery, immediately where small fissures or blowers were sending out gas, and very often they got ignited; but there was never any damage done to either myself or the men that were with me, having a good current of air passing by us.

1530. At the time to which you allude candles were the only means used to light those mines?—Yes.

1531. Was it the practice of the miners or mechanics employed in the pits to light a blower by means of their candles for the purpose of seeing how it would blaze?—It was frequently done in places where they considered the quantity too small to burn anybody; I have frequently done it myself, and it is a very beautiful sight to see the flame flying above you, provided it is not so large as to be dangerous.

1532. Is it done with the view of consuming the gas?—No, it is not; I have sometimes set fire to it at a distance, by putting a candle upon a long piece of wood, but that was merely for my own amusement. I wanted to see the velocity of the flame along the roof, when I knew that there was not that quantity to do any injury.

1533. Do not you apprehend that similar curiosity in other parties led them to try similar experiments?—No, I do not know that anybody made experiments but myself; I know that several of the miners used to leave me when I told them that I was going to light the gas; I was always aware that I had a good current of air in the neighbourhood, and that the blower could not be large enough to burn anybody.

1534. Might not a large blower, of which you were not aware, be exploded by that current of lighted gas?—No, that lighted gas could not reach any other blower.

1535. Have you ever in fact known any accidents resulting from such experiments?—No, I have not myself. Seeing the gas lighted up, and seeing the velocity that it passed along the roof, my attention was drawn to the contriving of a lamp, seeing it required a given time to pass over a given distance.

1536. Were your experiments such as to lead you to any practical conclusions as to the direction taken by the gas, and the circumstances under which it exploded?—They were.

1537. Will you have the goodness to state what the results were chemically and mechanically?—I will give the Committee my idea mechanically, because I knew nothing of chemistry at that time. My idea of making a lamp was entirely on mechanical principles; and I think I shall be found to be correct in my views, from mechanical reasoning. I knew well that the heated air from the fire drove round a smoke-jack, and that caused me to know that I could have a power from it; I knew very well that a steam-engine chimney was built for the purpose of causing a strong current of air through the fire. Having those facts before me, and knowing the properties of heated air, I amused myself with lighting one of the blowers in the neighbourhood where I had to erect machinery. I had it on fire, and holding my candle to the windward, (it was not so large but that I could approach close to it,) the volume of flame was coming out the size of my two hands; and, having the candle to the windward of the flame, it changed its colour. I then got two candles, and placed them to the windward; it changed colour still more, and became duller; I got a great number of candles, and placed them all to the windward, and the blower ceased to burn. This then gave me the idea, that if I could construct my lamp so as, with a chimney at the top, to cause a current, it would never fire at the top of a chimney; and by seeing the velocity that the ignited fire-damp passed along the roof, I considered that if I could produce a current through tubes in a lamp equal to the current that I saw passing along the roof, I should make a lamp that could be taken into an explosive mixture without exploding externally. My first lamp was constructed on that principle, having a chimney at the top of the lamp and a tube at the bottom, to admit the atmospheric air, or fire-damp and air, to feed the burner or combustion of the lamp. I was not aware as to the quantity required to feed the combustion; but to know what quantity was necessary, I had a slide at the bottom of the first tube in my lamp, to admit such a quantity as might be found necessary to keep up the combustion of the lamp. This lamp was made, and tried in the mine on 21st October 1815. Mr. Wood and the underviewer were with me when I made the trial at one of the blowers. I recollect that I went up by myself to a place where it was considered dangerous to go; this lamp was tried at the blower, and Mr. Wood

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went with me the second or third time. It always went out when exposed to hydrogen gas; but the lamp required to be carried very steadily, on account, I imagined, of the burnt air (as I then called it), or the azotic gas, that lodged round the exterior of the flame; and if the lamp was moved backwards and forwards, that poisonous air came in contact with the flame and put it out.

1538. That is, the extinction was more rapid than when the lamp was at rest?—Yes. It then struck me, if I put more tubes in, I should discharge that poisonous matter that hung around the flame, by admitting the air to the exterior part of the flame; I therefore got a lamp with three tubes of a diameter considerably less, and this was tried in the mine November 4, 1815. I found it would burn much better than the other, and I tried it at some of the blowers. The result was the same as in the first lamp, as to going out when it came into contact with hydrogen gas. These new tubes pointing towards the flame, whenever the inflammable gas came to the point of explosion in the lamp, it ran back to the tubes, but did not go down them, but simply ran from the burner to the tubes, and burnt for a short time and then went out. This was a proof to me that I did not require the tubes so long, because it did not actually go into them at all. Then my next lamp had a double perforated plate at the bottom, with the holes considerably smaller. I did not still know of what size the holes should be, but I made them very small, seeing that they did not actually pass into the larger tubes of the other or three-tube lamp. This lamp was tried immediately after November 4, and found to burn extremely well; and the principle of the lamp now before the Committee is precisely the same, though the shape is rather different. That lamp was tried at the Philosophical Society in Newcastle, and certainly before any other lamp had made its appearance.

1539. Have you found the current upwards always sufficient to prevent any explosion?—I have, but I heard Mr. Wood read some part of a book by Sir Humprey Davy, where he says—

1540. Do you allude to this paragraph, to be found in page 19? "Where currents are occasioned in concentrate explosive mixtures by the air-feeders in the lamp being below, and made with *thick* metallic plates or canals, there being an increment of heat within, and a very small radiating space without, as the heat increases the combustion of the explosive mixture will gradually extend further, and at last communicate with the external air."—Upon this paragraph I remark, that it is quite impossible that the lamp can be in that condition, and I will give the reason.

1541. You will observe also a note, in which Sir Humphrey Davy uses these words, "I warn the coal-miner against any pretended safety lamps made in this manner"?—Yes, it is impossible that the lamp can be in that condition, because the heat never comes to that part of the lamp, the combustion is going on above that part, and it is the very last part that can be heated. The lamp never filling with flame, it cannot come to that part, for as soon as the combustion increases a little in size, it goes out, it never goes down to those holes, therefore it is impossible that they can ever heat, or that the external atmosphere can be ignited in the manner represented by Sir Humphrey Davy.

1542. Therefore you do not participate in the fears entertained by Mr. Wood, as to the lamp which he has produced, No. 5, as an improvement upon Sir Humphrey Davy's lamp?—I do not. The Committee will allow me to refer to another part, where Sir Humphrey Davy speaks of a small hole being made in the bottom of the lamp, the lamp being charged with inflammable gas, having a cylinder round the wire.

1543. Are you quoting from page 97 on those words, "A small aperture was drilled at the bottom of a wire-gauze lamp, in the cylindrical ring which confined the wire-gauze, this, though less than 1-18th of an inch in diameter, passed the flame and fired the external atmosphere?"—Yes. Now, for a lamp to be in that state, it must be filled, before ignited, with inflammable gas, and how it is to be ignited I cannot see, for according to that statement, it is to be lighted after it is filled with gas, and having a close cylinder round it, it becomes like a gun, the flame is driven through the small aperture. Sir Humphrey Davy is quite correct in saying that if there were a great number of apertures it would get out with so much ease that it would not fire through, but it is impossible that any lamp can exist in the state he supposes.

1544. The upward current would entirely prevent the possibility of a reflux of ignited gas?—Certainly. I made several experiments (and Mr. Wood was with

me at the time) as to the velocity required in tubes of different diameters to prevent explosion from fire-damp, and we made the mixtures in all proportions of light carburetted hydrogen with atmospheric air in the receiver, and we found by the experiments, that when a current of the most explosive mixture that we could make was forced up a tube four-tenths of an inch in diameter, the necessary current was nine inches in a second to prevent it coming down that tube. Those experiments were repeated several times; we had two or three blows up in making the experiments by the flame getting down into the receiver, though we had a piece of very fine wire-gauze put at the bottom of the pipe, between the receiver and the pipe through which we were forcing the current. In one of those experiments, I was watching the flame in the tube, my son was taking the vibrations of the pendulum of the clock, Mr. Wood was attending to give me the column of water as I called for it to keep the current up to a certain point; as I saw the flame descending in the tube I called for more water, and he unfortunately turned the cock the wrong way, the current ceased, the flame went down the tube, and all our implements were blown to pieces, which at that time we were not very well able to replenish.

1545. At this time had you had access to any scientific works, or had intercourse with any scientific men, which enabled you to give a more decided turn to your experiments on the safety lamp?—No, I had no information given me by any books on anything that could assist me upon that point. The lamp is a good deal modified from what it then was; the drawings may be seen in a work now upon the table.

1546. Did you make further experiments at the time you are speaking of?—Several experiments were made in the mine with the lamp. After Sir Humphrey Davy's lamp had come, we took both the lamps together into the mine, Mr. Wood was with me, and we made several experiments with those two, as to which could be carried farthest into an inflammable atmosphere.

1547. Do you consider Sir Humphrey Davy's views of the efficiency of the lamp constructed by him to have been based upon mechanical or chemical principles?—On chemical principles.

1548. And your own on mechanical principles?—Certainly, entirely.

1549. Has further consideration of the subject led you to make any change in your views upon the subject?—I am more strongly convinced than ever that my lamp, properly constructed, is the safest lamp that could be made use of. So long as the glass keeps whole it never can fill with flame, and I have seen the glass crack, but never knew it fall to pieces in the lamp, as it only cracks to ease the expansion or contraction, and remains safe.

1550. But you do not mean to say that your original lamp of unprotected glass would be equally safe with No. 5 now produced, do you?—No, I mean with the wire-gauze outside that it is certainly the safest lamp; I do not think it is so safe when it was protected by the shield that I had originally, in case the glass broke.

1551. You admit that the combination of your own lamp and Sir Humphrey Davy's has produced a lamp which under certain contingencies is superior?—I think so, and indeed in every case.

1552. You have stated that the Killingworth mine is very inflammable?—It is.

1553. Have not your lamps been always in use in that mine?—I believe so.

1554. And in Springwell mine?—Perhaps they have, but I am not aware; I have never heard of an accident taking place at Killingworth with those lamps. As a proof, there have been very few accidents since those lamps have been used.

1555. Do you consider Killingworth a dangerous pit?—Yes, it was very dangerous when I used to go down, and at one time, after the air returned from the workings to the furnace, you could see large sheets of fire rising from the inflammable air as it passed over the furnace; it was then in a very dangerous state.

1556. Do you consider that improved lamp, in a sound state, to be perfectly secure in an explosive atmosphere?—I think quite so.

1557. Your last answer had reference to No. 5?—Yes.

1558. As you had an opportunity at the former sitting of the Committee of hearing one of the witnesses describe the lamps which he had produced, and which are now on the table, is the Committee to understand that under ordinary circumstances you would give a decided preference to No. 5?—I think it is a more perfect lamp than any I have seen. Mr. Roberts's lamp, No. 6, is on the same principle as this, but it is a little altered as to the mode of the air coming to the combustion; the principle is precisely the same.

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1559. Do not you consider Mr. Roberts's lamp objectionable on account of the glass chamber being placed externally?—It is; and I beg to state, that if Sir Humphrey Davy's lamp is made use of, I think that invention of Dr. Clanny's is a very ingenious one; the only difficulty I see is in getting the miner to manage it.

1560. Have you been acquainted with Dr. Clanny for some time?—I knew his name for some time, but I never had the pleasure of being in his company till I saw him here; I knew of Dr. Clanny having invented a lamp before any other person had brought them forward.

1561. Do not you think that Dr. Clanny exhibited the principle which has been employed by yourself and Sir Humphrey Davy?—The principle is not the same; but I think he was the first person that invented a lamp to be taken into an explosive atmosphere.

1562. Having had an opportunity of inspecting the workings of many of the most important mines in the kingdom, will you give the Committee your idea of the best mode to be pursued to obtain a thorough ventilation of a coal-mine?—I do not know that I could recommend any better mode than the use of the furnace. I do not think that anything could be made to equal it. The ventilation in collieries is certainly very faulty, but how it may be remedied I do not yet see. The present mode of ventilating is something like having a leaky cask of water, which you can only carry so far till the water runs all out. I have taken some pains to measure the quantity that was passing down the Killingworth pit at one time: it is from 600 to 700 hogsheads a minute of atmospheric air, that sets off on its journey round the workings, and perhaps there is not more than one hogshead a minute that reaches the distant part of the mine. There are so many stoppings and doors that it has to pass, all of which leak a little, so that a great part of the current returns to the shaft without completing its journey round the mine. I have known instances where the ventilation was so very bad at the most distant part of the mine, that meetings have been called by the viewer of all those who have charge, to be examined by him as to what was best to be done, to find out where the fault was. The result generally was, that the waste should be examined, which was a very tedious task to do, to see if any circumstance had taken place to prevent the circulation going on. I have been one of the number going into the old waste to endeavour to find out the cause of the diminished ventilation. It is necessary to have small doors in different parts of the mine to get into the waste, for the wastemen could not begin and travel round the whole track, they must therefore take it in different portions. In this case there were a number of us divided into lots of three together, and we set off to travel the waste to find out the faulty place. At the stoppings sometimes there was more leakage than ought to have been: this was attended to; some parts of the roof had fallen down so as to diminish the size of the passage of air; this was also remedied; and we got the current round the mine to be better after finishing our task. I imagine that many accidents must be occasioned by such interruptions of the ventilation as I have just alluded to.

1563. Can you consider the facts you have stated to prove anything short of gross neglect upon the parties who have the charge of that mine, either the superior or inferior officers?—I do not know how far that would be the case.

1564. First, as to the stoppings?—The thill rising, which invariably does take place more or less in mines, might derange the stoppings in one night, and a fall might take place, and of course they do not know that there is any defect till it is felt by the diminished current. There are men for the purpose of going round these places, and it depends upon their honesty how far they may travel in searching those different places.

1565. Have you reason for a moment to suppose that all this want of repair in the stoppings and in the doors was the result of one night's alteration in the mine?—No, I should think not; it might be, but I do not recollect the circumstances, though I should think not. The first explosion alluded to was from the want of a furnace; that was previous to this case of which I am speaking; there was no furnace in the pit when that first blast took place.

1566. Was it not known that a furnace would produce the desired effect of improving the ventilation?—Yes, but it was thought that the mine had not been carried on to an extent to require a furnace; but I know that the very day that accident took place the overlookers were very much alarmed, and that was the cause of the men going to prepare for the furnace that night.

1567. Is not that what is called in the north "running matters very fine?"—It certainly was; the furnace ought to have been on sooner.

1568. Do

1568. Do you consider, as an engineer, that sufficient pains has been taken to experiment upon mechanical forces at the mouth of the shaft, in accelerating the draught of mines which have the aid of furnaces?—There has been a great deal done with pumping out the air; it has been tried both by the pumping in and pumping out, and it was found better to pump it out; but that mode of ventilation was only considered necessary when the fire-damp was so very large in quantity, that if it had passed over the furnace, it would have fired and exploded the whole mine.

1569. Will you describe any mechanical means you have ever seen adopted in addition to the common air-pump for the purpose of injecting or exhausting the mine?—It is the common air-pump made in a simple way; it may be done with fanners, but still it is the principle of the air-pump.

1570. An ingenious gentleman has suggested a large fan in the mode of the winnowing-machine at the top of the shaft; can you furnish an idea of what effect that would have?—It would not be so good as the furnace.

1571. As an auxiliary to a furnace?—It would assist; but if it got out of order, and was required to be repaired; if it had been the only means of cleaning the mine before, and it got out of repair, as soon as it stopped, the mine would become foul.

1572. The Committee have supposed a case in which the mine was in actual operation, and in which it might communicate with the external air, when the machine was not in actual operation?—Yes; but if it was necessary to have a winnowing-machine to keep the pit clear of hydrogen gas, as soon as it ceased, the furnace might not be sufficient to keep it clear; if it was necessary to have that, over and above the furnace, to keep it clear, of course the furnace alone could not do it.

1573. Can you suppose a case in which, when the furnaces are used with the greatest advantages, the mine could be kept entirely cleaned?—No, I believe not.

1574. Have you taken into consideration the immense velocity with which such machine might be moved, and the indefinite quantity of air which might be dispersed or cast down?—There is no doubt that a machine might be made to exhaust the air very rapidly; certainly if you increase the furnace, you might double it, or even more than that; and it might be very useful in many cases, for when the mine becomes very extensive, the furnace ought to be increased in power, if it could be done so; because the more extensive the mines are the greater the friction of the air in getting round; I think in many mines it requires, perhaps, a quarter of a pound per square inch difference between the down-cast and the up-cast shaft, which is a great difference in the pressure of the atmosphere; I have tried the barometer in both sides, and at the time that I tried it, it was nearly a quarter of a pound per square inch, which the draught in the furnace caused. If you take a barometer round the mine, it will be found regularly to go down till you come to the balance in going, that is, the air becomes rarer and rarer the further it goes into the workings, forcing its way round to the furnace, where it is the most rare.

1575. You have spoken of the difficulties that would arise from the derangement of such a machine as has been suggested, would those derangements be more serious or likely to be more frequent than such as are continually occurring in the pumping and drawing machines, and in other parts of the underground works?—No, I do not think it would be so liable to be deranged; it might be put up more simply, and I have no doubt it might be a great benefit to the mine.

1576. Have you any doubt of such a machine being so constructed as to exhaust to an indefinite extent?—I have not.

1577. Do not you think that such a machine might be very simply constructed, and very conveniently connected with the other machines in use in such a pit in ordinary circumstances?—I do not think it could be attached or combined with any of the other machinery; it must be entirely by itself, because the other engines are stopped so very often that I think it ought not to be attached so as to be worked with them. I think it ought to be an engine entirely by itself; and having two, if one was stopped for repair, you might of course have the other for work.

1578. Have you any other suggestions to make as to the best means of injecting air or exhausting damp?—No; I have always considered the furnace the best. If any means could be made use of to measure the quantity of air passed to the most distant part of the mine, so as to insure a sufficient ventilation at that part. I think it is possible that such an apparatus may be constructed to measure the current, so

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as to give the miner notice, that he may prepare to find out the defective parts that the current has to pass through.

1579. Furnaces are sometimes placed at the top of the pit, are they not?—Yes, but they are not so good; the deeper the pit, the more effect the furnace will have in causing ventilation.

1580. Might not a furnace at the top of the pit be made an auxiliary to that at the bottom?—It might, but it would have a very slight effect compared with a very small addition of fire at the bottom.

1581. By putting a broad chimney at the top of the pit, would not that greatly increase the draught?—It would be much better to have it at the bottom, because any chimney which you have at the top has very little effect.

1582. Then you think an increased size to the furnace at the bottom would effect all the purposes of a furnace at the top?—Yes, much more effectually.

1583. So far as your own experience goes, has any decided improvement been made in the last 10 years in the mode of laying out extensive coal workings, so far as regards improvements in ventilation?—I think not.

1584. You are not aware of anything which can be considered as a change of system?—I think not.

1585. Is there not a new system used of commencing the first workings of the new field of coal on first sinking a new shaft?—I think there has been no improvement these last 10 or even 20 years; that if a new colliery were opened out now, the same plan would be resorted to that was followed 20 years ago.

1586. You say that there has been no improvement in the ventilation of mines, are you aware of a patent being in existence for the improvement in the ventilation of large rooms in mills and print-shops?—I do not know that I am; but I think what might be applicable to rooms would not be applicable to a mine. I do not think that any pipes could be applied to a mine. If we think of the number of miles that the air has to travel, and if there were pipes of six feet diameter, they are liable to be crushed by the thill arising and the roof coming down. It would be much more deranged than the present plan. I think those that have thought of pipes have not known the very extensive workings which exist in mines.

1587. What is the greatest extent of continuous air coursing which you have known in operation in any one mine?—That I cannot tell exactly, but I should think 30 miles or upwards.

1588. Then the current that is passing in the downcast shaft must travel 30 miles before any part is expended in the up-cast shaft?—Yes.

1589. Witnesses have stated that the greatest danger with respect to explosions occurs in working out the pillars?—I dare say it may; on this account, that you cannot have the ventilation so perfect because of the wide space that is formed by taking away the pillars.

1590. Do you think that the mines should be worked on the principle of leaving the pillars till afterwards?—There are different opinions upon that. I think it is better to work the pillars as we go on. I am doing so in Leicestershire. I take the coal as I go, not leaving pillars, except very trifling ones, but there is so great a difference in mines as to the manner in which they ought to be worked; some mines will do very well to work on one plan which will not do for another.

1591. That will depend upon the roof and thill?—Yes.

1592. But as a general principle with regard to ventilation, do not you prefer driving away to your boundary and working home?—If it could be done.

1593. Does not such a course of working obviate much of the danger, both from explosions and falls, in robbing the pillars?—I think it would.

1594. Is not every means possible now tried to lay out a new mine on that system of working?—Yes; going to the extent of the boundary and working backwards. I believe it is in many cases, but certainly it is not so in others. I have not done so in Leicestershire. Each compartment, where the men are working, is 24 yards wide; I leave four yards coal that I never intend to come to again, and then I have 24 yards more.

1595. But you are aware that in many mines in the north of England no such system could possibly be adopted?—I think it would not pay so well, but it might be adopted.

1596. That is to say, that the mines could not be worked profitably on such a system?—I think so; of course it is filled up as we go on, and it is with some difficulty that we can get the space that is formed by taking out the coal to hold the refuse.

1597. Do

1597. Do you sacrifice a certain portion of the coal in this mine in Leicestershire?—Yes, four yards, as I before stated.

1598. What is the rise in the Killingworth mine?—It varies very much; in some parts it rises six inches in a yard, others four, others three; some parts are nearly level; it is a very dislocated coal-field indeed.

1599. Do you consider that the more level the mine is, the more liable to firedamp?—No, I should think not; I should think quite the reverse. If you have an ascending mine, that is ascending in working the coal from the shaft, it is more difficult to get that mine ventilated than if you descend; the gas being lighter than atmospheric air, it will not come down the hill so well as go up, and of course, if you work your mines up the hill, your current must come down, and we find it more difficult to work a mine of that kind, as far as the ventilation is concerned, than working it down hill.

1600. On that account, would it not be always desirable to have a shaft for the ventilation of the mine at the upper part?—Yes; but supposing there was a fault to take place half way, and coal was thrown down 100 yards or 40 yards, that quite deranges the plan, you could not then make use of it.

1601. That is to say, that long before you could avail yourself of your second shaft, you might have proved the impossibility of reaching it?—Yes, it was so at Killingworth, we had the faults in all directions.

1602. What is the mode of working in the north which they call "robbing?"—It is taking so much of the old pillars off as they think can be got off without bringing down the roof upon them.

1603. Are you aware whether that term "robbing" has a different signification in Staffordshire from what it has in the north?—I am not aware of it.

*1603. Do you not know that it is the practice to turn out at certain distances and get coals, instead of going to the extent of the works?—I believe it is.

1604. Then would not the air collect in those cavities, and become very dangerous?—Certainly, very much so; many accidents have taken place by such places being left.

1605. Do you consider the proper ventilation of a mine to depend upon the bratices being perfect and in good order, the stoppings perfect and tight, the trap-doors properly regulated, and the boys and men regularly attentive to their duty in those particulars, and at the furnaces?—Of course.

1606. Do you approve of obtaining ventilation by braticed shafts, where two shafts can be obtained at a moderate expense?—I would prefer certainly having two shafts, they are better than one large one with a bratice.

1607. Is not the first mischief, in case of explosion, generally occasioned by blowing off the bottom part of the bratice, and thus destroying the main current?—It was so in the accident I alluded to at Killingworth.

1608. This would not have occurred to the same extent if two shafts had been the means of communication?—It could not.

1609. In what way are the stoppings ordinarily constructed?—Generally with bricks and lime.

1610. Can you suggest any better mode of forming stoppings?—I think not.

1611. Do you consider it justifiable to intrust young boys with the charge of such trap-doors as have a decided effect upon the ventilation of the whole mine?—I think many of the boys that are put to such purposes are too young, but with respect to a boy of 11 or 12 years old, I do not know whether he ought to be entrusted with doors in a dangerous mine or not.

1612. What age, as a general rule, would you consider the earliest at which the boy should have such a situation of trust?—It depends upon the situation of the door, for I think a boy of 10 years old would do well enough for many doors, and ought not to be entrusted with others of a more important description, as some doors in a particular part of the pit might have the effect of deranging the whole mine, while doors in another part will only have the effect of deranging a small portion.

1613. Whose duty do you apprehend it to be to discriminate as to the importance of those stations?—Of course the manager of the colliery, the viewer.

1614. Are you aware whether it is the practice to select either boys or men on account of their known stability and judgment, for such situations?—I am not aware that any particular choice has been made as to selecting those persons.

1615. In point of fact, are adults ever employed for such purposes?—I believe not, I have not known it so.

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1616. Have you ever seen children of eight or nine years of age so employed?—I believe younger than that; I believe children of seven or eight years old have been put to those situations; I do not know how it may be now in the north, but I know it used to be so; for sometimes it has happened that the father has carried the child to the colliery on his back, he being so young; but that I think is not the case now.

1617. The exertion for the child in the pit is nothing more than sitting in a recess to open and shut a door at intervals?—Exactly, by a cord.

1618. Therefore you consider the instances you have given as a proof of the very infantile state of the child?—Yes.

1619. Those men who carried the children on their backs were exposing themselves to danger in case of an accident?—Yes.

1620. But still their wish to employ their children was stronger than the feeling of danger that they incurred?—It was.

1621. Do you think the health of the children so employed suffers, as far as your own observation has gone?—I am not aware that it does; I think the pit-men generally are healthy men; they are very cleanly men in the north of England, more so than in any other part of England that I have seen.

1622. And this employment at the doors is the ordinary introduction to their future labours?—Yes.

1623. Do you think that the introduction of the Davy lamp has had the effect of making the overmen more careless in the ventilation of the mine or not?—I think it has had that effect; I cannot see how those accidents can take place without neglect on the part of some person. If the Davy lamp is found safe in an explosive mixture when it is tried, how do those accidents take place, unless it is either by not using the Davy lamp, or from its defective state.

1624. Supposing the case of a mine in the ordinary way of working with candles, and from some defect in the ventilation, or some general defect produced by circumstances which have come on rather gradually, the men are required to use Davy's lamps, are any additional wages given to them?—I think not, I am not aware that there is.

1625. What is the additional expense incurred by the coal proprietors in case of the lamp being required in the mine?—Very little; I cannot see that there could be much difference in the cost.

1626. Then is the effect of the introduction of lamps merely the expense to the proprietors?—It is.

1627. And some persons employed to take care of the lamps?—Yes, of course, there ought always to be a proper person to take care of the lamps.

1628. Is there not one man commonly appropriated to the care of the Davy's?—I believe there is.

1629. Are you aware of any instances of men having received any additional pay for their trouble or expense in attending to the Davy's?—I am not aware of it, it has not come within my knowledge.

1630. Is the introduction of the lamp in a mine generally the effect of the requisition of the men, or is it the effect of danger being apprehended by the overmen in the mine?—I think it will occasionally arise on both sides.

1631. Is there a disinclination on the part of the men to use the lamp, if there is a doubt as to the necessity of it?—I think the men like better to work with the naked candle, but I never heard that there was much objection to use the lamp.

1632. Supposing the men should be of opinion that it is unnecessary to use the Davy lamp, would they object to use it in that case, if they doubted the necessity of it?—I do not know that; if the overmen gave the orders, the men must attend to them.

1633. If he was not present at the time that they were working, and they did not concur in the necessity of the lamp, would not they be inclined to dispense with it?—I imagine that if the miner thought there was no necessity for the lamp, he would rather have the candle; but I think that ought not to be left to his choice, if there were any apprehension of danger; I think some men might wish to work with the candle, and others would care very little about it.

1634. Do you think that any portion of the accidents which occur in the coal mines is caused by the disinclination on the part of the men to use the lamps, not considering them necessary?—I think it may be.

1635. There is a great waste of candles in the drift of a coal mine, is there not?—Yes, there is.

1636. So that you think in the mine the use of the lamp would not be more expensive than the use of candles?—I do not think it would be.

1637. Is it the custom in the north to use the common oil lamp in any instances?—No, it is used in the horse roads, but not where the men work the coal.

1638. Are you aware that in the south and west of England the oil lamps are preferred by the wastemen?—No, I am not aware of it.

1639. Supposing the Davy lamp had not been discovered, do you think that there would have been greater care taken in the ventilation of the mines where fire-damp exists than at present?—They could not have worked some of the mines under the old system.

1640. Do not you think it desirable so to ventilate the mine in the most unfavourable state of the atmosphere, as to render the use of the candle safe?—No, I think not; it is difficult to do it in all cases; there are so many contingencies, the stoppings and the doors are so numerous, that if they get out of order, which they will do by the rising of the thill, or the roof coming down, it will derange the process.

1641. Is it not required, in order to keep the ventilation of the mine very perfect, to reduce the explosive mixture below a certain amount of quantity?—Of course it is, and that is the duty of the wastemen to see that that ventilation is kept up; the viewers are very strict indeed upon the wastemen in making them attend to their duty; but it is impossible that they can know whether they do attend to their duty, because they are altogether from the view of any person above them; they may go into the workings and lie down, and not travel one mile per day, the master cannot tell whether they have done so or not.

1642. If by the present system of the ventilation of mines they were able to keep down the inflammable gas below the point of the lamp, would not a little additional care and experience keep it so much below as to render the use of candles safe?—If there was a little more attention paid, the ventilation would be kept up in many cases.

1643. Do you not think that there is neglect in not doing so?—In many cases there is, or those accidents would not take place.

1644. Do you think it possible to keep the gas down below the explosive point of the candle as easily as below the explosive point of the lamp?—It depends upon the extent of the workings; if they are very extensive it requires a very powerful furnace to drive the air round the whole of the workings, and with very little derangement of the doors or stoppings, a sufficient quantity of air will not go through the mine, but will come to the furnace without completing its journey.

1645. Then a good or a bad ventilation of a mine depends very much upon the size of the pits compared with the extent of workings?—Of course.

1646. Has not the effect of the Davy lamp been to reduce the number of pits in a given quantity of mining?—Perhaps it may have been.

1647. If the pits were more frequent, the air would not have so far to travel?—Exactly.

1648. The extent of the pits is very considerable?—Yes.

1649. With regard to the braticed pits, it is common in the north to make use of part of the braticed pit for lifting the coal, keeping the other portion for the purpose of ventilation?—Yes, I have known one shaft of 14 feet diameter divided into four quarters.

1650. Is not that bratice work liable to be worn, and may not that occasion danger?—It is attended to every week, in order to preserve it; but there is more tendency to get out of order when they are so used.

1651. If that were prohibited altogether, what do you think would be the effect?—The ventilation would certainly be more certain with two shafts separated.

1652. Supposing a single shaft to be used, and bratices were never used for any purpose but that of ventilation, do you think that that would be an improvement?—No, I do not think that it would; it would save a little wear and tear, but it requires a quantity of water to be kept on the bratice to prevent the furnace burning it, and that must be attended to.

1653. You think if the use of bratice shafts were prohibited, it would be of great use in ventilating mines?—Yes, the thickness of the earth between the two shafts takes the place of the partition.

1654. The current of air would be much less liable to be deranged from the circumstance of being injured from the bratice giving way?—Of course.

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1655. Do you think that would be a decided improvement in ventilation?—I think so; I have adopted that mode myself in my pits.

1656. Would the expense of that be very considerable?—No, I do not think that there is much difference in the expense.

1657. The expense of sinking two shafts of a certain size is not much more than the expense of sinking one of a larger size?—I think not.

1658. Do you think that a point of so much importance as to be worthy of legislative interference?—I think it is one of those points that would insure a more certain ventilation.

1659. And that it would be sufficiently important to justify legislative interference?—I think so.

1660. Do you consider a stopping, that is by a brick partition, much more efficient than providing air by a bratice?—Yes; nothing comes against that stopping except the moving of the thill, or the falling of the roof; it has nothing more to do than to form a barrier between the two currents of air.

1661. In all cases where it is necessary to make a partition, you think a stopping should be adopted?—Yes, I think so; it is the best mode in the workings.

1662. Is it usual to make use of stopping instead of bratice?—Never to become permanent. Bratices are made use of where the men are working, for it is necessary that the men should work a certain length before those openings or holings are made where the stoppings are afterwards put in. The stoppings are merely put in to convey the air towards the men, but there is always a space which requires (if the pit is very highly charged with inflammable gas) the bratice carried on beyond the stopping to get a current of air quite up to the men.

1663. Can the bratice be necessary, unless you want to pass the air through a trap door?—Yes; it is necessary for 20 yards. The air goes up on one side and comes down the other. At the end of that 20 yards a holing is made, then the bratice is carried forward again as the man proceeds. It is taken down, in the first instance, because the current of air goes up to that holing without the bratice as soon as the holing is made.

1664. Have you any doubt as to a considerable number of mines being wrought by aid of the safety-lamp, which, without that discovery, would have been entirely valueless?—I believe there are many, but I cannot speak from my own knowledge, but I believe that it is so.

1665. Have you any doubt of the coal-miners of the north having derived very great pecuniary advantages from that discovery?—I think some have and some have not; of course where misfortunes have taken place they have suffered more than they have gained by a great deal.

1666. You think that one terrible accident has destroyed the profits of previous workings?—I think so.

1667. Still you think that as the coal owners rely upon their workmen, the overmen and others, the lamp may have had the tendency to make the men more careless in the ventilation of mines than they would otherwise have been?—I think in some instances it is so.

1668. Do you think sufficient pains and care are taken to instruct the underviewers, the overmen, the wastemen, and the deputies, in their respective duties?—I dare say there is a great deal of care taken to give them proper instructions; I believe there is; but I think there might be some instruments kept in the mines to be a continual guide to the miner when he goes down. I believe it very rarely happens that accidents have taken place to any great extent but only at the time when the barometer stood low. Now if a good large barometer was kept at the bottom of each mine, which the overlooker, the wasteman, or those that have any charge, should have an opportunity of seeing it, would put him on his guard in some measure to look out for danger. I have made some experiments myself on blowers to prove how this would act. I have gone down when the barometer has stood very low; I found some of the blowers or fissures throwing out very great quantities of gas. I have gone again when the barometer has stood high, and the very same blower that was sending out the quantity of gas when the barometer stood low, were taking in the atmosphere, so that there was not near the quantity of gas. In fact, it is not possible that the quantity of gas can come out when the barometer stands high that does when it stands low, because the atmosphere is varied in its pressure considerably.

1669. But to render that experiment conclusive, would it not be necessary that it should be repeated, that is to say, might not a specific alteration have taken place

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in the quantity of gas evolved from other contingent causes?—I repeated it many times; and that very blower, I believe, continued to blow 10 years. It was out of the rock, and not out of the coal; and the great blowers and fissures are generally in the rock; there is a hissing from the coal from the small openings, which Mr. Wood has described in the slices of coal shown to you; but the greatest quantity comes always out of the stone, either from the thill or roof, and this was the case of the blower that I alluded to that continued for 10 years, which became very faint at the end of that time. If I had gone to make an experiment soon after it was opened, it would not have acted as I have stated, but still there would have been a diminution of the quantity discharged in proportion to the change of the weight of the atmosphere.

1670. You wish the Committee to understand, that the experiments you made were at such short intervals, but under such determinate changes of the barometer, as to lead you to a decided conclusion, that those accidents are frequently the result of the excessive quantity of gas thrown into the mine by the diminished pressure of the surrounding atmosphere, when the barometer indicates such a change of atmosphere?—I do. I sometimes went to get gas to make experiments with the lamp. Of course when the blower was stopped by the atmospheric air I could not get it. I had to go to another place where it was blown out more strongly.

1671. Your theory is, that a vacuum had previously been formed by gas thrown out of the blower, which nature sought to replace by the air which rushed back again into that blower?—Yes; it was so little pressed by the external pressure as to allow it to come out in one case. In another case the external pressure became greater than the internal pressure, and of course it would always incline to balance itself and equalize the pressure.

1672. Can you give the Committee an idea of the extent of the variation in the mercury as graduated in inches?—It would vary about three inches, or rather more.

1673. Do you recollect the extremes under which your experiments were performed?—I did not take the barometer with me at the time; I have made many experiments with it underground, as to finding out the different pressures of the up-cast shaft and the down-cast shaft.

1674. Have you ever seen an instrument called a sympiesometer?—I do not know it by that name.

1675. An instrument intended to indicate with much greater nicety the changes or the approaching changes in the state of the atmosphere?—I have not seen one.

1676. Have you observed any difference in the ventilation of mines in summer and winter?—I know that the accidents generally take place in summer; of course the summer air has not so much expansibility in it as the same volume in winter would have.

1677. Is it not the case that the barometer stands higher considerably in summer than in winter, and that the density of the atmosphere is less in winter than in summer?—I do not know that there is much difference; there may be; I think the whole pressure must remain the same in all cases.

1678. In rainy weather is not the density of the air less than in summer?—Yes, but you will see it equally low in a storm in summer, the barometer having little to do with the temperature, but merely the weight; I do not think that an expansive state of the atmosphere, as that in summer, can have anything to do with the pit, though the column may be a little longer.

1679. Is it not the case in summer that the barometer stands much higher than it does in general in winter, except only in a shower of rain or a thunder storm?—I should think it very likely.

1680. Whatever may be the cause, does not the barometer show the absolute density on the surface of the earth?—I am not aware that there is any particular difference between summer and winter; there may be that difference, but it must ease itself into other parts of the globe.

1681. Do you think that the small difference of density indicated by 14 lb. an inch and 15 lb. an inch, would be sufficient to cause diminution or increase of the carburetted hydrogen from the fissure?—I think in one case a very large quantity of gas might come out, and in the other very little might come out; indeed I know that it is the case.

1682. Then the great advantage which you would anticipate from the use of the tube barometer always in sight of the underviewers and wastemen, would be to stimulate them to an increase of care under certain changes?—I think so.

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I used to give my instructions to the wastemen in Killingworth upon that very point, and many got barometers from my observations to them.

1683. Are you aware whether they have continued to make observations?—I dare say they do, but I cannot speak to that, not having been among them lately.

1684. Are you aware whether their experience in any way corroborated you?—Yes, I am sure that some of them did; I was so familiar with them, and talked to them about it, and we knew that such a change took place.

1685. They acknowledged that the mine was in a fouler state whenever the barometer indicated a diminished pressure of atmosphere?—Yes, and it was a common observation of the wastemen, that the explosion was caused by the south wind, which occasioned this state of the barometer; before they knew anything of the barometer, that was the observation that they made.

1686. In many mines is it not the case that the hewers on turning out and finding a warm south-west wind, decline proceeding to work?—I believe it has been so.

1687. You describe the blower to come from the cleft of the rock; does it not come from a small cleft?—Sometimes it is large and sometimes small; the openings of the rock vary very much.

1688. Did you ever attempt to stop back the blower?—No, I think it would be of no use; when there is a crack in the rock it may continue for miles, and I think those cracks have been formed when the dislocations of the strata took place.

1689. You are speaking of the crack in the roof?—Yes, I have never seen a blower come immediately from the coal; you will hear a hissing from the coal, but not a blower.

1690. It is generally in the roof above the coal?—Yes, or from the thill below, but more constantly when driving the stone drifts between the dislocated parts.

1691. Then you think the gas in that case comes from some other part of the coal-field in the neighbourhood?—I think it may come for miles; having known that a blower did continue to blow for 10 years, of course that did not come from the immediate neighbourhood of that coal.

1692. Would it not be possible to stop that drift?—No, I think not; it would, if stopped, have found its way in some other part.

1693. In case of water exuding from the same crack, could you not stop the water?—No, I think not.

1694. Is it not a common case to stop water even under more pressure?—In a shaft you may, but not there.

1695. Can you suggest anything by which the danger from accidents in mines might be diminished?—I do not know that the present ventilation can be improved, there have been some observations made, whether a machine could not be applied on the principle of a large fan, to assist the furnace in pumping out the air; I think there is no doubt that it would assist, but I think the great difficulty is getting the air conveyed to the neighbourhood of the shaft. There are so many places where it can get back by a shorter course, through doors and stoppings; at many of the stoppings you can hear a little hissing through, and of course whatever does come through, diminishes the quantity that first set off on its journey to go round the mine.

1696. Are you acquainted with the mode of working coal in the long work?—Yes.

1697. All the men working together?—Yes.

1698. Have you seen that adopted in the north?—It has been tried and given up; but in a thick bed of coal you cannot do that, you leave such a large space behind you that you cannot carry the current through all that part, and if it is all worked away the roof will frequently come down unexpectedly, and when it does come down, the quantity of hydrogen gas it drives out would make it more dangerous than the present plan.

1699. Would it be practicable to work the coal on that plan?—I think not with advantage.

1700. Would not that obviate the necessity of a change of present current into so many directions?—It would diminish the distance that it would have to travel, but I think the danger would be increased by leaving those large spaces. The stone would be sure to come down frequently, and every time it did come down it would interrupt the ventilation.

1701. You were asked relative to the instructions given to the pitmen; have

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you not in some of the collieries under your charge printed instructions which are delivered to every workman in the mine?—Yes, instructions, but not printed.

1702. Are there not printed instructions by you for the better management of the work in Pendleton mine?—That is under the care of my brother, Mr. Robert Stephenson; I believe there are printed instructions.

1703. Do not you consider, in addition to furnishing the overmen with barometers or instruments, such printed instructions, adapted to the various portions of the work, and distributed annually, would be of great use?—I think it would. That is a colliery very highly charged with inflammable gas; I mean Pendleton mine.

1704. Have you seen those instructions?—I think not, I think my brother told me about them.

1705. Are you aware that the electric spark will cause explosions of different mixtures of atmospheric air and light carburetted hydrogen?—I have not made the experiments myself.

1706. Do you doubt the fact?—No, I do not; I think it depends upon the degree of inflammability.

1707. How far would you suppose, as a scientific man, such a fact being established, it possible to be applicable to sudden explosions in coal mines?—I do not see how it could be applicable in the coal mines.

1708. You think that the electric spark is never given out below the surface of the earth in sufficient quantity to produce combustion?—I think there is not the slightest possibility of that, on account of the moist atmosphere, which will not hold the electric spark; it is conducted always down into solids.

1709. Are you not aware that the electric spark has been seen to ascend from the surface of the earth?—I do not see the possibility of it.

1710. Is it not so stated?—I cannot say the earth becomes positively charged, and the air or cloud becomes negatively charged, it may be so.

1711. Do you think all the accidents in lightning are caused by the descent of the fluid?—Yes, probably never the reverse.

1712. Did you ever read this passage? "I found that the common electric spark would not explode five parts of air and one of fire-damp, though it exploded six parts of air and one of damp."—Yes, I can easily conceive that such an experiment can be made, but it was by artificial means, it would be by an electrical machine or from a galvanic battery, getting the spark artificially.

1713. Do you consider that that was his opinion on reading further, "But very strong sparks on the discharge of a Leyden jar seemed to have the same power of exploding different mixtures of gas as the flame of a taper." Do you think the descent of the electric fluid into the earth is at all times perceptible?—No, I do not imagine that he is referring there to any discharge of the electric fluid from the atmosphere, but in the Leyden jar, it was then obtained from the electrical machine.

1714. Do you think it never exists in the atmosphere in as concentrated a state as in a galvanic battery?—I think it cannot be, I have tried to collect it with copper wires on a very large scale; I have had 500 yards of copper wire sent up by a kite for the purpose. No electricity could be obtained in damp weather. In the middle of the winter it could always be collected in the greatest quantities, and of such intensity that we could electrify anything by the wire merely from the kite.

1715. Do you mean to say that the discharge that throws down a house is not equal to the discharge from a common battery?—Far more so; you might make the battery equal to anything by increasing the size, but when a house is thrown down, that is a current of electric fluid thrown out of the atmosphere.

1716. Do you consider that such a current would not cause explosion if it came upon a magazine of inflammable gas?—I think it might by descending in that way, if that were possible.

1717. Do you think it quite impossible that such a portion may remain to ignite that magazine below the surface of the earth?—I do.

1718. On what ground do you give that answer?—As soon as ever it reaches the earth it immediately becomes eased by the immense mass that takes it in. I will take a tree that is struck by lightning: the tree is sometimes shattered to pieces, but you do not see the ground disturbed at all, yet the fluid goes into the ground.

1719. Do you consider that the tree, although a conductor, offers any resistance

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to the passage of the electric fluid, as compared with the atmosphere?—I think it does; when once it catches the points of a tree it immediately seizes the tree with great rapidity; while it is acting upon the branches it very rarely disturbs the branches, from the immense space occupied by them, but when once brought into the trunk it is frequently shivered to pieces, from the small space it has to pass in.

1720. Then you apprehend, that although radiation takes place as regards the branches of the tree, the fluid becomes again concentrated in the trunk of the tree?—It is concentrated of course in the trunk, in taking the first part of the trunk, but it is instantaneously given into the ground, passing through the trunk downwards.

1721. If conductors within the surface of the earth operate so as to radiate the electric fluid, do you conceive it impossible, that by certain metallic earths it may again be concentrated and conveyed to a magazine of inflammable gas?—Perhaps so; the conductor, that which is put up for the purpose of preventing the lightning striking the house, has not the effect of conducting the lightning down to the ground, but the effect of cleaning the atmosphere round the conductor, so that there is not a quantity left to attract the lightning to come into that district; if it was put into the street it would have the effect of cleaning the atmosphere in the neighbourhood even where it did not touch any house, the same as the wire that I was alluding to that was sent into the atmosphere, of course it collected the electric fluid in the immediate neighbourhood of the wire, and it was brought down; therefore that part of the atmosphere where the kite was, was cleaner than a short distance from it, and if the lightning was to come, it has not the same chance of flying into the part where it is less charged with electric fluid than where it is more charged.

1722. Do you mean to say that the electric spark cannot be conveyed by conductors into the earth?—I mean to say that it can, and it is; but not in quantities.

1723. How do you draw the distinction between a rod of iron and a metallic vein, as conveying the electric spark from a given point in the atmosphere to a given point below the surface of the earth?—From the immense quantity of the earth itself through which it passes.

1724. Is dry siliceous earth, or a metallic vein, the better conductor?—Of course the metallic vein.

1725. Will the electric spark, from natural laws, follow the metallic conductor in preference to the earth by which it is surrounded?—I think part of it may, but the greatest portion will rest in the mass it meets with.

1726. Is it more than theory to suppose, that a sufficient quantity may not remain to explode gas below the surface of the earth, when experiment has proved that a simple Leyden jar will furnish a sufficient quantity to produce that effect?—But it is confined in the Leyden jar by a non-conducting substance; it is kept there by force; if the Leyden jar was a conductor, it would not remain there.

1727. A metallic vein, and dry earth, and moistened earth, are relative conductors and non-conductors?—Yes, of course.

1728. Is not that an approximation to the fact as regards the Leyden jar?—In some degree it is.

1729. But you still adhere to your first opinion, that the electric spark is never conveyed to a sufficient depth in a concentrated quantity, sufficient to ignite inflammable gas?—I think not in coal-mines.

1730. By what means could the electric spark be conveyed down a shaft, unless it were conveyed by the sides of the shaft, or by some good conductor, from the top to the bottom of the shaft?—I have never known or heard of an instance of it; it might go down rods, but it cannot go down the air, and the rods are connected with the shafts in some instances, when I think it would soon be delivered into the sides of the shaft.

1731. Do not you think, that the tree is splintered in consequence of being an imperfect conductor of the fluid?—It is not a good conductor.

1732. Supposing, instead of a tree, a metallic substance in the same shape as the tree, do you think that the electric fluid would injure such a substance?—I think it would.

1733. Why does it not injure a piece of metal put up to protect a house?—We know that whenever the electric fluid does come in the neighbourhood of metallic substances

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substances it melts them. I never heard of an instance of any mine being fired by lightning to my knowledge.

1734. Have you ever heard of a plan that has been brought forward by Mr. Goldsworthy Gurney, of lighting mines by reflection?—Yes, I have heard something about it; I did not hear a full account of it, but I perfectly understand the general outline.

1735. What is your opinion of it?—I do not think it is very practicable; I think it is possible to do it, but do not think it can be kept up to be useful.

1736. Do not you think that a burner on Mr. Gurney's principle might be placed in a safe part of the mine, so as effectually to illuminate a very dangerous section of the mine?—I think it might.

1737. Would not that be an advantage?—For that particular spot it would; but I think it would be very difficult indeed to convey it from place to place by reflectors.

1738. You therefore confine the answer to the terms of the question, to illuminate a dangerous section of the mine?—Yes.

1739. Would it be very expensive to try this plan?—I should think not.

1740. Have you ever been able to judge from a sight of his experiment, of the intensity of his light?—Yes, I have made experiments myself with it; it certainly is a very brilliant light.

1741. Will it reflect a shadow, according to your experiments, through a favourable atmosphere of 10 miles distance?—I did not try it as to that; it was in the tunnel of Liverpool railway that I tried it.

1742. Do you think that a very highly concentrated light is as useful a light for persons to see and read in, as a light that is more diffused and not so concentrated at the point from which it issued?—It must be carried in points, it is only as a concentrated light that you can carry it, for if thrown upon a large reflector it will travel a very short distance; if you concentrate it you will carry it to a great distance, but the light will be in a point, and I do not know whether it will be found to be of much use at a distance or not.

1743. Though more perceptible at a great distance, it does not afford so much light to the person who wants light, as a light less concentrated but more diffuseable?—That is the case; if you were to be at a great distance and hold your hand between you and the light, you would see your hand; but if you turned yourself half-round, you could not see it with the light.

1744. It is of greater power in penetrating the atmosphere, but not so great a power in diffusing light over a space?—Exactly; if you reflect the rays it must be in concentrated points.

1745. Are you acquainted with the mines in the neighbourhood of Whitehaven;—No, I have not been in those mines; I know the country, but I have never been concerned in them.

1746. Have you descended any of Lord Carlisle's mines near Brampton?—I have.

1747. Are those fiery mines?—No, they are not.

1748. In the West Riding of Yorkshire, have you descended the mines?—No, I have not, not that I recollect at present.

1749. Are you aware whether the mines belonging to Mr. Brandling near Leeds are fiery mines or not?—That I cannot speak to; I believe they may be.

1750. Have you descended any of the mines in Staffordshire?—I have.

1751. Are any of those fiery mines?—Yes, they are.

1752. Speaking relatively, are they more or less so than the average of mines on the banks of the Tyne and Wear?—Less so.

1753. Have you observed whether the safety-lamp was in use in those mines?—Not at the time I entered them.

1754. Did you consider that the mines were perfectly safe at the time you examined them?—In some places, in others not.

1755. Your opinion was that the miners were running great risk of explosion?—Yes, to a certain degree; but not to such an extent as in the north, on account of the limited scale of their workings.

1756. In Derbyshire have you descended the mines?—I have not.

1757. In Lancashire?—Yes, in the neighbourhood of Newton I have.

1758. About what depth?—I think about 200 yards.

1759. Did they appear to be working in a foul atmosphere?—They were, certainly.

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1760. Were the safety-lamps in use?—Yes, they were.

1761. Universally?—No, not in every part of the mine.

1762. Did the miners appear to you to be running great risks?—They certainly did, and as a proof that they did run a risk, there was an explosion took place in the mine that I am alluding to, and 12 men were lost.

1763. Within the last three months?—No, I think it is 18 months ago.

1764. Have you not heard of an accident within the last three weeks of a mine in the neighbourhood of Ashton?—I think I have.

1765. Do you think that those mines can be justifiably wrought without safety-lamps?—I should think not.

1766. Have you descended any other of the Lancashire mines?—Yes, I have, one belonging to Mr. John Bourne & Co., 50 or 60 yards in depth, and that did not discharge much inflammable gas.

1767. Do you think they may be safely wrought with candles?—I think they might.

1768. In Leicestershire, with which you are particularly acquainted, are the mines fiery mines?—A little certainly, but not to any great extent.

1769. At what depth are you working there?—222 yards.

1770. Have you employed the safety-lamp?—No; as soon as ever the pit was sunk to the bottom, I applied the furnace to keep a good ventilation round the mine.

1771. And you rely upon the furnace?—Of course. I have made experiments as to the quantity of gas that is discharging, and I found it a small quantity. There is a good deal of carbonic acid gas comes out of the coal, which prevents the hydrogen gas being so ready for explosion.

1772. Do you anticipate, in the further prosecution of your workings, such an increase of gas as to render the use of your lamp desirable?—It may be, but I do not know that at present.

1773. Have you descended any mines in Warwickshire, in the neighbourhood of West Bromwich, Walsall or Dudley?—Merely in the neighbourhood of West Bromwich; that is some time ago.

1774. Are those fiery mines?—I think they are all in the thick coal, and are fiery.

1775. Have you been in the 30 feet seam?—I have.

1776. Were the lamps in use in those mines?—Not at that time.

1777. Have you a recollection as to how far you were satisfied with the ventilation being such as to preclude risk to the miners?—The ventilation certainly was not good, only so long as the men kept in certain districts the current kept them safe, but if they went out of that district then the danger was considerable.

1778. Were they working with candles?—Yes.

1779. A curious workman taking his candle into a waste might have led to an explosion of the whole mine?—Of course, and they frequently did so.

1780. Have you visited the mines in North Wales in Flintshire, on the banks of the Dee?—On the south side I have, belonging to Sir Thomas Stanley.

1781. Are those fiery mines?—Not when I was there.

1782. Have you visited the mines in South Wales?—Partially I have.

1783. Are those fiery mines?—Not those where I was.

1784. None in which the introduction of the lamp appeared necessary?—Not then, it is some time since; it was near Swansea.

1785. Have you visited the lead, tin, and copper mines of Cornwall?—I have not.

1786. Have you visited any mines of Scotland?—Some mines I have.

1787. Of what districts?—Belonging to the Duke of Portland, near Kilmarnock.

1788. In Ayrshire?—Yes.

1789. Are those fiery mines?—I think not, but it is so many years ago that I do not recollect.

1790. Have you visited any of the Irish mines?—I have not.

1791. Have you visited any of the mines in Belgium or Hainault?—I have; but I did not go down the pits there. Two of my young men that were with me were very desirous to go, but I would not allow them, after hearing the state of the workings. I believe that great care is taken in keeping things in order, but accidents do occur: at Liege, in some parts, the coal is in a perpendicular position; before the dislocation took place, it appears that the coal-field has been considerably larger in extent than at present; and it is lapped over. Supposing it to have been formed of one horizontal plane, it has been thrown up so as to pass one plane above the level of the other into a zig-zag position.

1792. Till

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1792. Till one plane was placed at right angles with the other?—Yes.

1793. That of course renders the effusion of carburetted hydrogen very copious?—Very much so; many cavities have been left for the gas to remain in, so that as they work the cavities out they are constantly meeting with those fissures or blowers.

1794. Have you any information as to the means which are used for the protection of the miner in those pits?—No, I do not know all those particulars. I believe great care is taken; at one pit they have 600 Davy lamps, and have yet had severe accidents.

1795. Do you allude to any means unknown in England, or not in use?—I believe there are means used there that are not in England, but I do not think I am justified in drawing any decided comparison between the one and the other.

1796. Is that formation peculiar to that country; are you not aware that in England there are formations of a similar kind?—No. In the neighbourhood of Newcastle-under-Lyne it is something like it, but not to any extent, the dislocation does not overthrow the lower level so much as it does in Belgium.

1797. Do you consider that that formation is more likely to abound in inflammable gas than in regular formations?—If the coal is rich coal it is. There are such a variety of seams of which some produce carbonic acid and some hydrogen gas, and some stone that produces neither one nor the other.

1798. You are not aware that the mines that have been referred to in the neighbourhood of Newcastle-under-Lyne do not abound with inflammable gas?—I know that there is some gas there, but as to the extent I am not aware; I know that the coal is very good, but a great part of that coal-field has openings to the surface, it is so dislocated that the coal is almost invariably out at the surface in some way or other, I think if you were to open the colliery to a greater extent at the dip you would have more hydrogen gas.

1799. Having seen the mines generally throughout the kingdom, do you consider that the subject of ventilation obtains that attention which the safety of the miner in those districts would appear imperatively to demand?—I think so.

1800. Do you think that in the southern counties there is any reference to any standard as to the quantity or velocity of atmospheric air which is required for the ventilation of any given mine?—I believe it has not been attended to so as to measure it in that way.

1801. Have you any doubt of the correctness of the principle?—I have not.

1802. Do not you think it of the first importance that those questions should be made the subject of arithmetical calculation?—I think it is very desirable to do so, if a certain current should be by law forced up to the neighbourhood of the mine in a certain area of space, I think it would be a great certainty as to preventing explosions; I do not know whether such a law can be carried into execution.

1803. In point of fact, although aware that a certain supply of atmospheric air must be obtained, do not you consider in many mines that there is a total ignorance of any theory as to the required extent and nature of the supply?—I believe quite so.

1804. Must not that required extent in all cases be referred to the quantity of gas to be carried off, as well as the quantity of atmospheric air to be consumed by the workmen, so that you can lay down no fixed rule?—That is the difficulty in the way of laying down a fixed rule, but there is no doubt that such a ventilation could be formed to considerable extent to make it safe, but whether it could be kept in that state seems the difficulty.

1805. May it not happen that one species of mine requires a certain velocity of current, when another mine requires a much greater velocity?—Yes.

1806. And therefore that would be a difficulty in laying down any rule which should apply to all cases?—It is difficult.

1807. But do not you consider that the manager of every mine may, by experience and experiments, ascertain such facts as will enable him to come to clear and specific conclusions of the current of air which he ought to have in his mine?—I think he could come to such a conclusion; he might make the calculation of what quantity he required, but the difficulty is in keeping the quantity up at any particular place.

1808. But would not his experience of that difficulty at certain times be an immediate incentive to extra care?—Of course.

1809. And would not this constant habitual practice of watching the demand and supply lead to the safety of the workmen?—I think it would in some degree.

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1810. Are you acquainted with the coal mines in France?—I am not.

1811. Do you know whether in the kingdom of Belgium there is a public officer, whose duty it is to examine the mines as to the safety and the extent of the workings?—I am not aware that it is so in Belgium; I saw the proprietors of mines, and I believe the mines at Liege are worked rather extensively.

1812. Are you aware that that is the case in France, that there is a public officer appointed by government to take care of all the mines, and inspect them with reference to their safety?—I have heard that there is such an officer, but I do not know it of my own knowledge.

1813. Do you consider the safety of mines to be a question of national importance?—Yes.

1814. Do you think it is of that importance as to justify the appointment of an officer of that description, and if such an officer was appointed, do you think that a code of laws could be established to prevent accidents in mines?—I think it might, but it requires so much consideration, that I could not give a decisive answer to that question at present.

1815. If a law of this kind were in operation, and some public officer had the power when he considered the mine in an insecure state to suspend the operations of the mine till it were safe, do you think that would be beneficial?—I think it would be beneficial; I think it would cause managers to be always on the alert; it does appear that there must be some neglect somewhere at present.

1816. Do you think it would be very difficult to work out the details of such a plan, so as to make it applicable to the different mines throughout the kingdom?—I think something might be done; but I should not like to give my idea of the details.

1817. You spoke of not being intimately acquainted with the mines in the neighbourhood of Dudley?—I know the mines very well, but I have not been down them.

1818. Are you aware that they are subject to frequent and tremendous explosions, attended with loss of life?—I am quite aware of that.

1819. Did you hear of an accident which happened on the 1st of September, in Oldbury, near Dudley, in the year 1833 or 1834, by which 13 persons were severely injured, of whom three are reported to be since dead?—I think I was passing in the coach at the time when I heard of it.

1820. Did you hear that accident, as regards its causes, explained?—I did not.

1821. As regards accidents arising to workmen in ascending and descending mines, have you any observations to make to the Committee by which the frequency of such accidents might be prevented?—I rather differ from Mr. Wood in that point; he prefers the loop; now we do not make use of that plan at the colliery that is under my own care; but they go down in one of those corves, and there is nobody allowed to get on the rope at all.

1822. Do you not think that the mode in which the men ascend and descend the mines in the north of England is one of peculiar hazard?—It does appear so, but not many accidents take place; they are so accustomed to it, and their nerves are not at all shaken by making use of that plan. I hardly ever knew an instance of a person falling off coming up.

1823. Why do you adopt such strict rules in your own colliery as that the men should not be allowed the use of that mode?—We use flat ropes, and they are not so convenient for the men; they might hang upon the chains, but I think that the corve will hold as many men as ought to go on the rope.

1824. Can any man see a banksman snatch 10 or 12 men and boys in succession from over an abyss of 300 or 400 yards without feeling for the risk of those men and boys?—It does look very dreadful.

1825. Your men stand up and lay hold of the rope?—Yes.

1826. How are they landed at the top?—When the corve comes up level with the top of the shaft the engine stops, and they get out one by one.

1827. There is no slide over the top?—No, I do not think that that increases the safety at all.

1828. How are they drawn to the side wall?—The man takes hold of the corve, and they step out. There is an overhanging part to one side of the landing-place or saddling boards, that they cannot come against it. In Lord Hastings's coal pits, which are within a few miles of Ashly, there were two or three serious accidents, by the men being drawn over the pulley. I do not know how many came up together, but I am sure all were killed but one; that time there

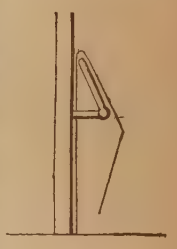
were

were four or five, and I think it has happened twice since. I have lived in Leicestershire for the last three years.

1829. To what was that owing?—The neglect of the brakesman, I suppose.

1830. Did you notice this contrivance of Mr. Sparrow's colliery at Lane End in Stafford, for landing men and coals?—I did.

1831. Will you describe that?—There are guide rods to prevent the corve coming in contact with the shaft, and of course there is a cross-bar so far above the corve, that when this rises for a certain distance above the top of the pit, there are two slides or little pieces of timber or iron that allow this bar to go past by yielding a little; by their own gravity, they fall into their situations again, then the engine-man or the brakesman stops his engine and allows it to turn backwards, and then the corve comes off upon the inclined plane, which is formed by the sliding pieces, lands the corve upon the saddle-boards, or the top of the pit.



1832. By what contrivance is the inclined plane passed underneath the corve?—The corve takes a slanting position at the cross-bar, being brought into that position.

1833. Do you consider the mode just described practicable under other circumstances?—It is quite practicable to be made use of, where there is a small quantity of coals to be drawn out of the pit; not for a large quantity.

1834. The guide-rods have been found very objectionable in the north of England?—They have not been made use of; they have been made use of in Yorkshire, but I think they are now disusing them.

1835. You think that that plan is applicable only to a limited outcast of coal?—I think so.

1836. Can you give the Committee an idea of what quantity of coals are brought to the surface; take for instance a mine of 100 fathoms depth, in what space would those men be brought up the shaft?—In a couple of minutes.

1837. Are you aware, that in a mine recently sunk in Sunderland, the coals are brought to the bank in two minutes and one-eighth from a depth of 265 fathoms?—I am. One of my young men happened to take the time when I was in the neighbourhood; that was the time I think that he stated; I was not at the pit at the time.

1838. Would you not think this a dangerous velocity?—I think it would be; but I do not think they draw men at that velocity.

1839. What quantity is brought at the time in a corve?—I believe they bring three up together, which may make a ton.

1840. Have you seen the employment of carriages in the mines in the south for bringing up the waggon which carries the quantity of coal?—I have.

1841. Do you think that advantageous?—It would do for a very small quantity; but you could not keep a sufficient quantity of horses and men employed without having a variety of roads.

1842. What is the largest quantity you have ever known brought out of one pit in a day of 12 hours?—I do not recollect exactly; but I should think 300 tons a day.

1843. Are you aware that the quantity brought from a single pit in the south frequently exceeds that, when carriages are employed on a platform?—I do not know an instance of it; I have often inquired whether they have done it; 50 tons a day is about the average quantity.

1844. Have you ever seen any pit where a quantity of water is sent down to the mine bringing up the carriage on the other side of the rope?—I have seen it used.

1845. Are you aware that they are employed to 50 or 60 fathoms depth?—Yes, they are made use of; but then you must have a place for discharging the water from the mine.

1846. Are you aware in those pits from 300 to 400 tons are brought up in a day?—No, I do not know it.

1847. You are aware that it is the practice to draw as many as three corves at once at some of the pits in the north?—Yes.

1848. Do any accidents to which the English miner is subject, in the course of his work, strike you as having been omitted to be noticed in the course of your examination?—I do not know that there are, except in situations where the carbonic acid gas is found; I think the Committee did not allude to that.

1849. Have you any suggestions to make by which mines may be readily freed from the carbonic acid gas, or the men saved from exposure to its noxious influence?—Nothing

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—Nothing more than proper ventilation; I have known a case, with respect to the effects of carbonic acid gas, of a man descending a shaft, and it must have arisen from the change of the barometer, for he had not gone down the shaft far before he had lost his breath, and was killed; and it appeared that the shaft was charged with carbonic acid gas, which prevented the mine being worked again till it was cleansed.

1850. Do you mean to say that where any suspicion is entertained of the presence of that gas, a careful man would be able, with a barometer, to ascertain the presence of that gas?—No.

1851. Carbonic acid gas is heavier than common air?—Yes.

1852. The case you allude to was a case of bad ventilation?—Yes.

1853. Does the lamp indicate proximity to danger?—It goes out. With respect to sulphuretted hydrogen gas, there was a case at Newbottle, where there were six men lost by that gas. I imagine that it was that kind of gas, for the lamps did burn while the men died. There were three men working in a drift, and one of them said he felt himself unwell: it was quite a separate place from the other part of the workmen, and he thought he would go out; and the other one said he thought he was not well also, and agreed to go out; and they did not go very far till one of them said he must sit down, he could not go any farther: they had a light with them, and the other man went on; and one of the men said he could not go on, and he also sat down, and there was one got out and gave the alarm. Mr. Hill was the viewer, and he happened to be at the colliery at the time, and he immediately prepared to go down the pit with all the men that had any charge in the mine. I think there were five besides himself, and they could not make out the cause, as the lamp burnt, of the men stopping; but Mr. Hill said to his men, "Let us use all the caution we can in proceeding to seek these men." He desired the men, in going forward, that there was nobody to speak unless they felt a change in the breathing, or any other change that they considered was a change of the vital powers. They left guides at different places to give the alarm to the shaft, in case there was anything amiss took place with them. They went on so far that at last Mr. Hill spoke, and said, "I feel a ringing in my ears; do any of you feel a change." When he spoke they all thought they felt some change; and he said, "Let us go back;" they turned round to go back, and all fell. There were some of them so strong as to give the alarm to the others, and fresh men came running in, and got, I think, two out of the six brought out alive. Mr. George Hill was one; he was brought out as a dead man, and was sent to the top of the pit in the corve, and Mr. Hill, and the other man, came to life; but the other four that were not got out so readily all died. In that case I think it must have been sulphuretted hydrogen gas; but it was never known what gas it was.

1854. Would not the effects be the same of carbonic acid gas?—The candle was not put out.

1855. Independently of the candle?—I think it would have the same effect if it was carbonic acid, independently of the candle.

1856. Might there not be a quantity of carbonic acid gas sufficient to impede their breathing, without putting out the candle?—No; I think a person can breathe pretty well some time after the light has gone out; I have tried it myself.

1857. If it had been sulphuretted hydrogen gas, would there not be a smell?—Very likely.

1858. Did they not describe that?—I do not recollect that Mr. Hill, who told me of it, alluded to any particular smell.

1859. What is your opinion of the health of the men employed in the mining districts in the north, as compared with that of the labouring classes which surround them?—I think their general health is quite as good as that of the labouring classes on the surface. I have generally considered them as very healthy; at least they used to be so. I do not know whether there is any change from the use of the lamp.

1860. Have you ever observed any difference between the men employed in those mines with pure air and those employed in fiery mines?—I have not formed an opinion upon that.

1861. There is no general opinion upon those being unfavourable to health?—No, there is not.

1862. Will you state to the Committee the general appearance of horses that are kept in coal-pits; does it not appear that they are always in a good state?—Certainly the horses appear to live well.

1863. Are they not always fine in their coats, and generally showing an appearance of health, unless it may be from the effect of their legs being in constant water?—They are very healthy.

1864. Is that influenced from their not changing their temperature?—I think it is.

1865. Do not you consider the coal-miners upon the whole a much more healthy class than the lead-miners?—I should think they are. I did know several lead-miners that certainly had the appearance of being very old men before they were old, and I attributed it to breathing so much carbonic acid gas, which is formed from blasting, and from not having a good ventilation to cast it off.

1866. So that, as a general question, you consider the coal-miners more healthy than the lead-miners?—I should think so.

1867. Did you observe any difference in the ventilation of those coal-mines where gunpowder is used extensively?—It is used extensively in some places, but it is diminishing. I think if you wish to have large coals, you ought not to use gunpowder: it is so shaken with the shock that when it is exposed to the atmosphere it falls to pieces.

1868. Are you aware that the use of gunpowder is very much increasing in the south?—No.

1869. But you are aware that many seams in the south do not leave room for the objection which you have just stated?—Yes.

1870. Are you of opinion that any large premium offered by the coal-owners in any certain district, would have an advantageous effect in turning the attention of men of native talent to these subjects?—I think it would be the means of bringing talent forward; if any person has thought more about it than another he comes forward under such circumstances.

1871. Do you think it would be desirable if scientific men were induced to visit the collieries and make experiments in the mines?—I think some good might arise from it.

1872. Can you conceive any means better adapted for pointing the public attention, and scientific men in particular, to this subject, than this inquiry, and its results made generally known?—I think this inquiry will be the means of throwing all the different plans of the management of collieries into the hands of the public at large, so that if any new idea strikes anybody with this information before them, they have now the opportunity of bringing forward new suggestions which they have not had an opportunity of doing before.

1873. Do you think it desirable that the plans presented to the Committee should be introduced in their minutes of proceedings, and given to the public?—I think they ought. All the plans ought to be exhibited, and a reference to the different improvements of ventilating, as exhibited by those plans. I think a different description ought to be made than appears upon the evidence; that it should be made shorter.

1874. Intelligible to men not practically acquainted with the subject?—Yes.

1875. Do you think it very desirable that the public should be informed in what respect the lamp is favourable, and in what respect it is deficient?—I think so.

Martis, 30° die Junii, 1835.

JOSEPH PEASE, ESQUIRE, IN THE CHAIR.

Mr. *George Upton*, called in; and Examined.

Mr. *George Upton.*

30 June 1835.

1876. ARE you resident in London?—I am, in Queen-street, Cheapside.

1877. Is your business that of a maker of lamps in great variety?—Yes.

1878. Have you ever turned your attention to the subject of lighting in coal mines?—Yes, much of it for several years, particularly since 1827.

1879. Have you ever had an opportunity of examining the coal mines in any part of England?—I have never been in a coal mine myself, though I have seen a great number of persons who have, and collected some information from them.

1880. You wish the Committee to understand, that the safe lighting of mines, in which carburetted hydrogen gas prevails in great quantities, has been the subject of your close consideration?—It has.

1881. Will you state to the Committee what have been the results of that consideration?—The first point was an examination of the Davy-lamp; I was induced to go particularly into that examination from it having been told me by my partner, Mr. Roberts, who had been a working miner for 25 years, that it was not safe.

1882. Had Mr. Roberts worked in the coal mines himself?—He had, from a boy; and previously to his giving me any information on the Davy-lamp, he had made several improvements in it, for which he had received a reward from the Society of Arts. In the course of our concerns in other matters, relative to lamps, he told me that he had found the Davy-lamp not to be safe.

1883. He stated that as the result of his own personal experience?—Yes. I was much surprised at that information, and doubted the correctness of it; I thought he might be mistaken, from the character that the Davy-lamp had previously borne.

1884. Did he enter into any particulars as to the circumstances under which he considered it not safe?—Yes; he stated that in the course of his life he had worked in some of the Staffordshire mines: the Earl of Lonsdale's, in Cumberland; Mr. Curwen's, at Workington, and some of the Newcastle mines, principally the Newbottle; that he had seen during that time the effects of many accidents, which had led him to suspect, as the Davy-lamp had in these cases, as far as he could judge, been managed with great care, that it was not so secure as had been represented. This led to an examination of the subject, which examination was putting it to the test of experiments; those experiments were such as satisfied me, as far as I could judge of the matter, that the lamp was not so secure as it ought to be, according to the uses which it was then put to. Not satisfied with my own experiments, I applied to several scientific persons, for I could hardly suppose it possible that Sir Humphrey Davy had been so much mistaken in the safety of his lamp as it appeared he had from what I then saw.

1885. Will you state what you did see?—The Davy-lamp was held perpendicularly and brought against a horizontal stream of gas from a common gas-pipe; the effect was, the passage of flame, in a very short time after the lamp had filled with the inflammable gas. On drawing the Davy-lamp back, and then putting it again to the jet of gas, the flame passed through the gauze cylinder and ignited the jet of gas outside.

1886. Was the lamp moved rapidly through the jet?—It was brought, not with a very rapid motion, but with a very moderate one, such as Mr. Roberts stated to me might be the action of a man lifting his lamp to see whether his basket was properly filled with coal.

1887. Were any means taken to increase the force of the current of gas?—Not any; the gas was received from the street; there was no control over its current.

1888. Were those experiments succeeded by any further experiment?—Yes, they were succeeded by many, but not perhaps marked by any peculiar circumstances different from what I have named. The next experiments, which were in many respects of a different nature, were tried by Mr. Pereira.

1889. Who is Mr. Pereira?—He is a member of the College of Surgeons, and lecturer

lecturer at the London Institution and London Hospital, the City of London, and at several other places. He is a person of importance as a lecturer, and a good authority on such a matter as the present; he has also a very large chemical school.

1890. Will you state what experiments this gentleman made on the lamp?—He confirmed the correctness of our statement, by a variety of trials.

1891. That is, the statement made by you and Mr. Roberts as to the result of your experiments on the Davy-lamp?—Yes; he tried two lamps that we produced, one a Davy-lamp, and examined it very strictly; but as the insecurity of the Davy-lamp appeared to him a wonderful matter, having had no notion of it before, he doubted whether the materials of the lamp he tried were perfect. He then had his own lamp brought, which had a double cylinder of wire-gauze.

1892. Did that lamp differ from the common Davy-lamp, save and except the double cylinder of gauze instead of the single?—Not in the least. He tried that lamp, and the result was the same with the double gauze; it took rather longer to pass the flame, but so little longer that the difference was immaterial as to the practical use of the lamp.

1893. Was the wire of the usual fineness?—It was finer than Sir Humphrey Davy ever stated to be necessary.

1894. Of what metal was it made?—Iron wire; there were 1,004, or about that number, of apertures in the square inch, and that doubled would of course be 2,008; copper wire, I believe, is used only at sea.

1895. Then Mr. Pereira became convinced that there were certain contingencies in which the lamp would explode the surrounding atmosphere?—Yes.

1896. Did you make any suggestions to him as to how that consequence might be obviated?—Both Mr. Roberts and myself did. We had been two or three years previously making experiments on safety-lamps; we then submitted our lamp to him, which he tried in the same way.

1897. Will you describe to the Committee in what respect that lamp varied from Sir Humphrey Davy's lamp?—The lamp of Sir Humphrey Davy's which is in general use, fills with flame immediately it is placed in an inflammable atmosphere; it receives the air through the meshes of the wire-gauze from the point of the wick to the top of the cage, as it may be required. In our lamp, which I will now produce, [*the Witness produced the same*] the air passes between a layer of wire-gauze and a cone before it can pass from the wick; the cone brings the whole air admitted into the lamp in immediate contact with the flame, or as nearly the whole of it as possible. The consequence is, that the air that passes from the wick has been rendered incapable of supporting flame by that contact, and consequently no other part of the lamp but at or near the wick is capable of supporting combustion; the advantage of which is, that the flame never comes in contact with the wire-gauze. It has not power, therefore, to act with force upon the top of the wire-gauze, which is most powerfully acted upon in Sir Humphrey Davy's lamp; the top is the most vulnerable part of his lamp. I should name that in our lamp a glass is put over the wire-gauze cage to drive the air under the horizontal layer of gauze below the wick, otherwise it would not pass that way.

1898. How is the air forced down?—It is drawn through certain protected holes by the flame of the wick, the access of air being prevented in all other parts of the lamp by the glass covering. If it were not for the glass, the air would go the readiest way, and pass through the gauze cage as it does in Sir H. Davy's lamp.

1899. How is the air prevented from going through now?—By the glass covering before stated; the current of air passes out of the top of the lamp.

1900. And you contract the upper orifice not more than to permit the exit of the air that is necessary?—The lamp wants it sufficiently large to keep up the supply of fresh air; because, if the burnt air were not let out of the glass chamber sufficiently quick to admit fresh air, it would destroy the combustion at the wick.

1901. And you make the orifice sufficiently large for that purpose?—Yes; it need not be nicely calculated; if it were a little more close or a little more open, it would not, perhaps, make much difference in the action of the lamp. An objection has been made which, perhaps, I may allude to, that it is a disadvantage the glass being on the outside: it was determined to place it on the outside, after a great deal of consideration and a great many experiments. It was found that the glass was in less danger from any external accident than from the risk of coming in contact with the flame; for if it were inside, and the lamp were to be put in a small degree out of the perpendicular, the flame would come in contact with the glass, and would be very likely to break it. Another advantage of the glass being outside

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the gauze, which is not very immaterial, is, that it keeps the wire-gauze clean, and free from the floating dust which, I am told, is a very great inconvenience, and sometimes chokes up the meshes of the wire-gauze.

1902. Suppose the glass to be perfect for the effect for which you use it, causing the current of air to pass down the lamp, what is the advantage of the gauze above the lamp?—The gauze is put there in case of an accident, such as the glass breaking; it would otherwise do as well without. In fact, the first lamps Sir Humphrey Davy made were entirely without wire-gauze; he did not then seem to have any notion that wire-gauze was necessary. Concentric rings were placed both at the top and the bottom of the lamps referred to; and I believe this omission of the wire-gauze in them led to the contention between him and Mr. Stephenson, or Mr. Stephenson's friends, as to the validity of his (Sir H. Davy's) claim on that point.

1903. Supposing the glass to break, the lamp is subject to all the accidents of a Davy-lamp?—Yes, it becomes a Davy-lamp at once, and is no worse or better, except that it has perhaps this advantage: the gauze having been less liable to accident from its previous covering, is likely to be more perfect than the gauze of the Davy-lamp, which is daily and hourly exposed to external friction and accidents. It being of a very delicate nature, it is very likely, and I have no doubt very frequently is subject to small derangements in its texture, which may escape the eye of the person whose duty it is to inspect it.

1904. Then none of those disadvantages would arise to the Davy-lamp, with the common glass over it?—The common Davy-lamp would go out with the glass over it.

1905. As far as keeping it clean?—Yes; but it would not act with a glass, and therefore a glass could not be so applied.

1906. The principal advantage of your lamp is, that the air which enters the lamp is directed downwards?—Yes, in its way to the wick.

1907. You also attach value to the rising cap, as being readily calculated to admit just a sufficient quantity of air, either of the atmosphere or combined with carburetted hydrogen, to preserve the combustion in the lamp?—Yes. [*The Witness lighted the lamp.*] The Committee will observe that the taper will not burn with the wick as in the Davy-lamp.

1908. Then, by the experiment of lighting the two, taper and wick, which you have just performed, under the glass, you exhaust the supply of air merely sufficient for one, and thus demonstrate the advantage of the surrounding glass chamber, as depriving the lamp of any obnoxious vapour from the surrounding parts of the mine?—Yes.

1909. Suppose the flame of the wick were near the top of the lamp, would not the gas reach it and be dangerous?—This is prevented by the following means: The flame of the wick, when acted on by inflammable air, instead of coming with any force against the top of the lamp, as with the Davy-lamp, rises merely as a smoky column, gradually narrowing at its extremity. The fact is, that flame cannot live with any force in an atmosphere of this kind: this has just been shown by the taper going out, while the wick continued burning, consequently the iron wire could not get red hot in such a situation.

1910. Is not the heat of that part of flame which is not visible often stronger than that which is visible?—In some cases, where it is least seen, it is so, but not in this.

1911. Supposing the extension of the flame, which always takes place in carburetted hydrogen, and that part of the flame which is not visible, which has greater heat than that which is visible, might not the gas explode in that point?—The flame could not, in such a case, get through the double cap of wire-gauze, as the wire-gauze cap would be protected by the continual passage of air through it not capable of supporting flame.

1912. You are aware that that part in a blow-pipe beyond the visible flame is the hottest?—Yes; but the blow-pipe has the advantage of pure atmospheric air, while the flame in this lamp above the cone which surrounds the wick, has all the disadvantage of meeting air that will not support combustion, at least, not to any great extent; consequently the flame would, under such circumstances, be very feeble.

1913. But much more air comes from below the light than is required to keep the light burning?—Yes; but its power of supporting flame has been taken from it by its previous use, for it is a known chemical fact, that air that has supported ignition will not again support it.

1914. Several

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1914. Several questions have been put to you with a view of ascertaining how far you have endeavoured to discover whether, in a chamber filled with carburetted hydrogen, this lamp will explode the carburetted hydrogen at the top of the chimney; have you ever performed an experiment, and what was the result?—The new lamp was perfectly secure in every trial to prove its safety, on this point.

1915. Has it been tried by any of the scientific gentlemen in the metropolis?—Yes.

1916. Will you give the names of those who tried the lamp?—I will give the names, if you please, in the order they occur in the trials made on the lamps. The lamps were tried first by Mr. Pereira.

1917. Was Mr. Pereira satisfied that your lamp was not liable to explode the surrounding atmosphere of carburetted hydrogen?—Yes; and beyond that, he tried it with oxy-hydrogen, which is a test that it cannot meet with naturally. He suggested that mode of trial.

1918. With a view of exposing it to a still more inflammable mixture?—Yes, he did. He also tried it in all the gradations of mixtures, from common coal gas to oxy-hydrogen gas.

1919. Was any explosion produced in any of those experiments?—In one instance only. It was with a lamp differently guarded to the present one, and which circumstance led to a very important alteration in the new lamp. It exploded with oxy-hydrogen, but the apertures at the base of the lamp were then guarded with perpendicular wire-gauze. It was afterwards found that the same mesh of gauze, if placed horizontally, would resist the passage of flame, which, if placed perpendicularly, would not; and in consequence the horizontal position of the wire-gauze, as a guard, is now adopted.

1920. Suppose the internal part of the gauze were filled with carburetted hydrogen, do you not think it possible that an explosion could take place downwards?—It was tried by injecting gas from the top. This was not done with very great force, but with more than was ever likely to happen.

1921. Do not you think it possible to explode the gas at the flame downwards, and through those meshes?—No; none of the trials hitherto made would warrant such a conclusion.

1922. You think the current is so strong as to prevent that?—Yes. If there were to be a counter current, the effect of which has been tried, by lifting the lamp very rapidly upward, it would put the lamp out, because it would drive upon the wick the carbonic acid and the nitrogen which had been formed by the combustion at the wick.

1923. That is, assuming the principle that the wick decomposes the whole of the air that has been admitted?—Yes.

1924. Will you name any other scientific gentleman that made experiments upon your lamp?—Mr. Partington, who is a professor of mechanical philosophy, and the author of the "British Cyclopædia," and a number of other scientific works. He was at the time at the London Institution. He did not go into any very extensive series of experiments, for he appeared to see the principle at once, and was satisfied.

1925. Can you name any other gentleman?—The next gentleman is Mr. Hemming; he is a lecturer of considerable repute. He made what is considered an improvement on Mr. Gurney's blow-pipe, which is now very much used at all the scientific institutions. I name that circumstance as a proof that he must be fully acquainted with the nature of gases.

1926. Had he the opportunity of experimenting upon your lamp?—He had; he was acquainted with the experiments on the lamps by Mr. Pereira; soon after the publication of a small pamphlet on the subject of the Davy-lamp, he told Mr. Pereira, that he could not credit, to its full extent, what he heard, unless he saw the experiment himself; that he must have ocular demonstration, for he had seen the Davy-lamp tried so constantly at scientific institutions, and had himself tried it in all the ways described by Sir Humphrey Davy, which appeared all that were necessary to prove its working condition in coal mines; he therefore could not readily credit what appeared so very surprising. He came, by appointment, to try the Davy-lamp, and brought his own lamp; he was even so particular that he would not suffer it to go out of his hands till he had tried it himself. The effect was the same as described by Mr. Pereira.

1927. He had previously conceived Sir Humphrey Davy's lamp to be a perfect protection?—Yes. The next gentleman I shall mention is, perhaps, the highest

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authority that I could give on a chemical subject, Dr. Turner, of the London University, who has published a work called "The Elements of Chemistry." He had been told of this circumstance by Mr. Hemming; he also doubted its correctness. He expressed a wish to experiment on the Davy-lamp and the new lamp. The new lamp was taken to him at the London University; he tried several experiments, and expressed much surprise at their result.

1928. Are you now alluding to agitating the safety-lamp with a view to produce explosion?—Yes; he agitated the lamp in the way I have described in my own and Mr. Roberts's experiments; he brought an action from a bladder on one side the lamp, containing gas (carburetted hydrogen), and then a second action on the opposite side, by a bladder containing the same kind of gas. By putting a small degree of force on each bladder, the gas exuded on the lamp.

1929. Was there much force used?—Not much; for he tried it to satisfy himself, and he was very particular in the mode in which he tried it.

1930. Does it not appear that the gas, with the smallest pressure igniting the other stream of gas, would force the flame through the gauze on the opposite side?—The flame was forced through with common carburetted hydrogen, which is not so sensitive as hydrogen and atmospheric air, and nothing like so sensitive as oxy-hydrogen, which backs immediately. If the mouth of a bladder containing this gas were to be brought in contact with the wire-gauze of a lighted Davy-lamp, the flame would fly back and light the gas outside the gauze; but carburetted hydrogen appears generally to go through on the opposite side to that on which it has been injected.

1931. And that seems to be the result of the experiment you describe, that the flame was blown through, and lighted the gas on the outside of the gauze?—Yes; I believe Dr. Turner has tried it nearly a dozen times. He has exhibited it at his lectures to his pupils in a variety of ways.

1932. Then Dr. Turner's pupils have become acquainted with the fact that under certain circumstances an explosive mixture will ignite outside of the Davy-lamp?—Yes; Dr. Birkbeck also tried the Davy-lamp in a lecture at the London Institution a short time back; he had previously tried it at his own house with the same result. During these trials the experiments have been exhibited on both lamps at the London Hospital, to a number of Mr. Pereira's pupils; there were perhaps 100 present. At the London University to a greater number of persons; the pupils are more numerous. Many persons connected with scientific pursuits, particularly chemical professors, were present on these occasions; they came to see what the experiments were; none made any objections to the mode of conducting them. The experiments on both lamps have been exhibited at the City of London several times, at the Mechanics' Institution, the Russell Institution, and lately at a scientific institution eastward.

1933. In all those experiments you of course made use of fictitious gases, prepared for the purpose?—Yes.

1934. Have you ever tried it with the carburetted hydrogen as evolved in the mines?—Yes.

1935. Were the results similar to those which you have described?—They were similar as to the flame passing; but to my surprise and to the surprise of the persons present, it passed much more quickly than carburetted hydrogen. The fire-damp, instead of appearing to be the least inflammable of combustible gases, as far as could be judged by its effects upon the lamp, appeared to be quicker in its action in passing through the wire-gauze, which became heated to a white heat almost in an instant.

1936. In that case you must have forced the current with a very strong impetus upon the gauze?—Not more than Mr. Roberts considered that a blower might force it. This experiment was tried in a coal mine near Dudley; there were at least 20 miners present.

1937. That is, supposing it had been close to the blower?—Yes. I have omitted to mention one circumstance, which is perhaps material in this inquiry. A meeting in March 1834, of about 40 of the principal mine owners of the county of Staffordshire took place at the gas-works at West Bromwich, to witness experiments on the Davy-lamp and the new lamp: these gentlemen had heard with surprise that the Davy-lamp was an insecure instrument, and nothing but ocular demonstration would convince them of the truth of this assertion. As they had been apprised by letter of the purport of the meeting several days previously, they were prepared with a number of lamps which they had been in the habit of using in the mines,

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as far as those lamps are used in Staffordshire, which is very limited. They had also a number of their men present; they were most of them persons of long experience in working coal mines. When they saw that none of their lamps would sustain the action of a jet of gas, they were much surprised, as the lamps had hitherto been considered safe.

1938. Do you know whether any explosions have taken place in the neighbourhood to which you allude?—Several had taken place previously to this meeting.

1939. Have any taken place subsequently?—I think I have read of one at Wednesbury, but none of any material consequence.

1940. From all those experiments, and assuming the fact that the damp found in the mines is still more explosive than the fictitious gases obtained by chemical preparation, you have come to the conclusion that Sir Humphrey Davy's lamp, under certain circumstances, is not a safe instrument?—I consider that Sir Humphrey Davy's lamp, in most of the uses which he recommends it for, and which uses have been sanctioned by several gentlemen of great experience, is extremely dangerous, and must lead occasionally to such catastrophes as those which have occurred lately at Springwell and Wallsend collieries.

1941. And the only contingencies that you apprehend as likely to create danger in your own lamp, is the fracture of the glass and of the gauze, and the burning of the top of the lamp?—The burning of the top of the lamp I think impossible, from the experiments I have seen, and from the nature of the atmosphere at the top of the lamp.

1942. Then the only contingencies are, the destruction of the lamp, that is to say, a fracture of the glass and a fracture of the gauze?—Yes.

1943. Do not you think that very much depends upon the size of the aperture at the top of the gauze?—No; the cap or cone immediately surrounding the wick has an opening at the top, and that circumscribes the size of the flame of the lamp, when filled with inflammable air. If that aperture be an inch in diameter, the flame would be an inch also in diameter; if it were half an inch, it would be half an inch only; and if it were two inches, the flame would be two inches. That is the only part of the lamp in which there need be any great exactness, and that exactness merely relates to having a proper space between the wire-gauze and the flame of the wick.

1944. Supposing there were no glass at all, would not your lamp be equally safe with that aperture?—No; the lamp would then fill it with flame, as the Davy-lamp does.

1945. The principle then is, that the supply either of atmospheric air, or combined with light carburetted hydrogen gas, is equal, and no more than adequate, for the supply of the wick?—No, that is not the principle which we have made the lamp upon; it might be regulated on such a principle, if necessary. The point which we have had in view, and which we have considered all that is necessary, is to make the aperture sufficiently large to let the air pass from the wick.

1946. Supposing there were some difficulty in the current going under the flame, if the opening at the top were sufficiently large, might not another current go by the sides of the glass, while the current from the lamp went up the centre?—The lamp would go out in that case.

1947. The result of your experiment is such as to lead you to believe that too much is attributed to the ignorance and carelessness of the miner, and too little to the dangerous circumstances in which the lamp is placed?—I believe so.

1948. Then you would draw a further inference, that some of the accidents that have occurred where the whole of parties engaged at the moment in the mine have been lost, ought to be accounted for from the contingencies to which you have alluded?—I do; and I will state the reason: it appears that carelessness, as far as the Davy-lamp is concerned, must be almost entirely confined to the taking off the cap, or, as it is called, the wire-gauze cage of the lamp, to get a better light. A gentleman who was examined before this Committee, I believe, stated, that on one occasion he had examined a lamp after the men had been burnt, and that he found there was some small derangement of the wire-gauze. The man, it appears, had, on the ignition of the gas, thrown the lamp away, which might have occasioned that derangement; but if the cap had been taken off, the lamp would have been found without it, and near the spot

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1949. But as you are not a practical miner, you have not taken sufficiently into consideration the circumstance of a miner deranging his lamp, under the impression that the mine is safe at that particular moment?—I can only consider it probable that he would derange it to get a better light. I cannot see any other motive, and no derangement but that of taking the cap off the lamp would give him a better light; therefore, till it be proved that some lamp is found with a cap off, I shall always doubt that the accident has been produced by such a circumstance, for I consider it not possible for a man under such circumstances to replace the cap.

1950. Might not the lamp be disarranged without the cap being taken off, supposing the side of the gauze was injured?—It might, but very little; and I think that sometimes the using candles, and at other times lamps, in the same part of a mine, has an injurious effect upon the care of the workmen.

1951. Do not you think that the lamp being placed by the viewer or the overman in the hands of a miner, is tantamount to saying the mine is not in a safe state, you must use particular care?—Yes; I have no doubt that it is so; but men will very often have to use a lamp instead of a candle. When the appearances are not sufficiently strong to indicate any sufficient reason for such a change, I have no doubt that they sometimes look upon it as a grievance, so far as their working is concerned, the candle giving the better light.

1952. Have you had some conversations with miners upon this subject?—I have. I beg to observe, that the light of the Davy-lamp cannot be increased without destroying its safety, even as far as it now extends. It is known that the heat of the flame is according to its bulk, and the consequence would be, that if Sir H. Davy had increased the cylinder of his wire-gauze lamp to the extent necessary for a larger wick, the power of such a body of flame would be so great as to oxydize or to burn the gauze to pieces in a short time. This is stated particularly by Doctor Turner, in the Elements of Chemistry.

1953. Do you happen to know whether the men working in mines demand a higher price for working with lamps than with candles?—I have heard that they used to do so. Mr. Roberts stated, that he could do a great deal more work with a candle than with a lamp.

1954. Will you describe what the general opinions of the men are as to the safety and the light of the lamp?—In Staffordshire there is one universal opinion as to its safety. I did not meet with a single instance of any person who had the least doubt of its safety; but the miners in Staffordshire, particularly in the very thick seams, do not work with it.

1955. Had they been accustomed to use the lamp?—Seldom or ever to work by.

1956. Have you ever in any place had a conversation with the men as to the light given by the Davy-lamp?—Yes; they stated that it was quite inadequate for the purpose for which they wanted it in the thick mines, to give them such a light as they could work by.

1957. Have you ever conversed with the men in the north of England, where it is used, as to the light given by the lamp compared with candles?—No, I have not; in the thin seams much more light would be got from it than in the thick ones.

1958. Are the men ever in the habit of using more than one lamp where it is required; two or three lamps together?—I saw one lamp, not a Davy-lamp, one of Mr. Stephenson's lamps, but it had not been used much.

1959. Was that on the principle of combination of the Davy-lamps?—Much such a lamp as the Committee have amongst Mr. Stephenson's on the table. The men were very anxious to get a better light than the Davy-lamp gave them. They were very anxious to work with lamps on account of the known or supposed safety of them over candles, but they found it impossible, as I have before stated, to work with the light of the Davy-lamp in the thick mines.

1960. Will you state whether you have taken into consideration the subject of general ventilation, independently of the use of lamps?—I have.

1961. Have you anything to state to the Committee upon that subject?—Only as connected with lamps; I have always considered that ventilation is in its nature specific, that is, adapted to the supposed quantity of gas produced in a regular way in the mines, and that it cannot be enlarged to such an extent as to meet sudden occurrences, such as the bursting of blowers, or the interruption of the ventilation of the

the mine, from falls and various matters that cannot always be guarded against: I therefore connect the subject with lamps in this way, that a real safety-lamp prevents any of such casual interruptions being of the serious consequence which they would be with a candle or an unsafe lamp. Supposing the case of an interruption of ventilation in any part of the mine, persons going into that part with a perfect lamp, that is, with a lamp that would not allow flame to pass, the circumstance of inflammable air being there, even to a great extent, would be known without its discovery being attended with more inconvenience than perhaps a disagreeable effect upon their breathing; but in the other case, the smallest interruption to the ventilation of the mine must, when a naked light or an imperfect lamp is used, be attended with bad consequences, and at times with those of a most destructive nature.

1962. Does any part of your lamp come under the operation of the existing patents?—The cone or cap is belonging to a patent that is now in force to a lamp.

1963. It forms a constituent part of the specification?—It does.

1964. How long has that patent to run?—Seven years.

1965. Have you made many lamps on the construction which you have submitted to the Committee?—Some few, but we have not yet attempted to sell any.

1966. Will you describe the result of some experiments made by Dr. Turner and other gentlemen; had either of the gentlemen tried the effect of the explosive mixture in your lamp?—Yes.

1967. Have they given an opinion upon it?—Yes, Dr. Turner has, and that opinion I can read.

1968. Do you quote a private letter?—No, from a public book, his "Elements of Chemistry." He says, in his fifth edition, "These principles suggest the conditions under which Davy's lamp would cease to be safe. If a lamp with its gauze red hot be exposed to a current of explosive mixture, the flame may possibly pass so rapidly as not to be cooled below the point of ignition, and in that case an accident might occur with a lamp which would be quite safe in a calm atmosphere. It has been lately shown by Messrs. Upton & Roberts, lamp manufacturers of this city, that flame may in this way be made to pass through the safety-lamp, as commonly constructed; and I am satisfied, from having witnessed some of these experiments, that the observation is correct. This, then, may account for accidents in coal mines where the safety-lamp is constantly employed. An obvious mode of avoiding such an evil is to diminish the apertures of the gauze; but this remedy is nearly impracticable, from the obstacle which very fine gauze causes to the diffusion of light: a better method is to surround the common safety-lamp with a glass cylinder, allowing air to enter solely at the bottom of the lamp, through wire-gauze of extreme fineness, placed horizontally, and to escape at the top by a similar contrivance. Upton & Roberts have constructed a lamp of this kind, through which I have in vain tried to cause the communication of flame, and which appears to me perfectly secure. In case an accident should break the glass, their lamp would be reduced to a safety-lamp of the common construction."

1969. Have any other scientific gentlemen given an opinion similar to that?—Mr. Pereira has.

1970. Can you quote his own words?—Yes: "The lamp Messrs. Upton & Roberts have invented appears a much more perfect instrument than the Davy-lamp; for in all the experiments hitherto made with it, the flame has not passed through the wire-gauze;" although the same means as are detailed above were resorted to in order to induce it to do so.

1971. Have you offered to any gentlemen in the North, where these Davy-lamps are used, to try your lamps?—No, we have not; and for this reason, that we have considered that the first trial of a lamp in a mine could never be carried to the point to which it ought, without so much danger that no person would be present at the time, if he could help it; because, if the lamp were put to the proper test, and did not bear it, an explosion to a very considerable extent might take place; and if it were not put to that test, it would be no trial of its powers. It is well known that artificial gases can be made of much greater explosive power than carburetted hydrogen, and I consider the lamp ought to be able to bear more than it could at any time, or under any circumstances, meet in a coal mine; its safety ought not to be limited to a doubtful point.

1972. Might not your lamp be put in some situation in a mine, where it would produce a partial explosion without producing a serious explosion?—No; if it

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produced an explosion in any case, it must be expected to produce it in all similar cases.

1973. Would that not be a trial of the lamp?—It might be so tried; there could be no objection to such a trial, after it had been tried elsewhere.

1974. You are quite aware, that in some of the galleries the air is foul on account of the ventilation of the mine not being communicated to that particular section?—Yes.

1975. And therefore an experiment might be made by placing the lamp in that section of the mine?—Yes; of course there could be no objection to that, or anything that might lead to a good effect.

1976. But if it were tried in one place and did not explode, it might be tried in other places?—There could be no possible objection to any trial to which it might be put, but I cannot see the utility of one of this nature.

1977. But you are aware that by such means hundreds of pitmen, unacquainted with the safety of these lamps, might be convinced of the utility of your invention?—Yes; but I think if they saw the lamp, and were told it was safer than the Davy-lamp, and gave a better light, which they would at once see, they would have no hesitation in using it.

1978. Would not the experiment, in some portion of the mine, where an explosion would be of no consequence except lighting the gas at that portion of the mine, convince the masters and the men too?—Yes, no doubt; but I think if the Committee were to have experiments made on the lamps by scientific men, and publish the results of those experiments, such a mode of proceeding would at once remove all doubt on the subject. I think this would be the shortest way, and so far desirable as every moment's delay may be attended with danger.

1979. Supposing the Committee should fix a day for the purpose of testing various lamps which have been brought before them, you are prepared to wait upon the Committee and assist in experimenting?—At any time.

1980. The Committee observe you have placed two lamps upon the table; is the one which you have not described essentially different from the one you have described?—Both are on the same principle. The large one has been brought to show the capability of the principle being adapted to a larger scale of action; the principle is not circumscribed by a particular sized wick or production of light, as Sir Humphrey Davy's lamp is.

1981. Then you apprehend that your lamp recommends itself to the owners of mines on the ground of safety and humanity, and that it recommends itself to the miner as affording a better light than one simply on the principle stated by Sir Humphrey Davy?—I do; and I think that the giving a better light will be a great inducement to the miner to fall readily into the use of a new lamp.

1982. Supposing that a second glass were introduced where the gauze is, would not the effect be the same?—Yes, if the gauze could be dispensed with, there would be better light.

1983. The principle of your light may be preserved as well with that alteration?—Yes; it does not want any gauze, other than to guard against external injuries.

1984. Therefore an improvement upon your lamp would be to have a glass instead of gauze?—Yes, as to light, but not safety; a gauze is placed to meet any unexpected accident, because if the glass were to be broken, and the gauze not to be there, explosions might ensue, as with the Davy-lamp.

1985. An accident that might destroy the two glasses, would not effectually destroy the gauze?—We have a lamp with two glasses, but we feel a little circumscribed in one respect. It is necessary to avoid if possible much complication; safety-lamps have to go into rough hands, and if they are very delicate or complicated, their parts would be likely to be injured or misplaced, and get out of order, to an extent that might render them at times ineffective.

1986. The price of your lamp, independently of the patent right, would not be very much greater than the price of Sir Humphrey Davy's lamp, would it?—We should be inclined to sell them at the price that lamps were generally sold at; getting a moderate profit. Though we should like to be repaid for a considerable outlay, yet rather than any impediment should be placed in the way of removing the cause of those accidents, we should be very moderate in our price.

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Mercurii, 1° *die Julii*, 1835.

JOSEPH PEASE, ESQUIRE, IN THE CHAIR.

Mr. *John Buddle*, called in; and Examined.

1987. YOU are extensively engaged in mining operations in the north of England?—I am. Mr. *John Buddle.*

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1988. You are aware of the nature of this inquiry?—I am. If the Committee would permit me, I should beg leave to make a few preliminary observations before my evidence is taken, inasmuch as I shall find it necessary to use a great many technicalities, which I think had better be explained in the first instance in a clear way, in order that my testimony may be better understood. I presume that the evidence of the witnesses whom the Committee have already examined, will have fully informed them as to what is meant by the "up-cast" and the "down-cast shaft;" I shall therefore say no more upon that subject than merely to state that the down-cast shaft is that by which the current or currents of atmospheric air are introduced into the mine; the up-cast shaft is that by which the vitiated current makes its exit. The next term which I shall have occasion to make use of is "air-course:" this is a general term; it merely signifies that the wind is blowing, or that the current of air is circulating. By descending into particulars, it is called the "run of the air;" the first of it is called the "in-take," and the last of it, when it ascends, is called the "return" in all cases; whether it is partial, as only from a single division of the mine that is ventilated, or whether it is coming to its exit at the up-cast pit, it is always called the "return." The return has various appellations, according to the degree of inflammability in which we find it. The first question I generally ask when I go down a pit, of the overman or any other responsible person, is, "What is the state of your returns this morning?" His reply is according to the state in which it then is, and is described as being "muddy" or "thick;" "heavy," that is the next degree; and the next to that is "fiery," meaning that it is absolutely explosive. I think I had also better describe what is meant by "brattice." Brattices are of two descriptions, according to the purposes for which they are used, main or shaft brattice, which the Committee will understand better by a reference to the section. This is a section of the unfortunate pit at Wallsend that exploded the other day. That is the whole depth from the surface down to the Bensham seam, on which the explosion took place. Here is the upper or main coal-seam; it is a large shaft, 14 feet in diameter, and was separated to the depth of the main coal-seam by a brattice of timber. There is a plan of the pit down to that depth; it was in three separate divisions or compartments, viz. an engine pit and two coal shafts. From the experience which I had in 1801, from the explosion in the A pit of this colliery, knocking out the shaft brattice, which was of the very strongest construction; the bottom part of it was formed by a parapet wall three feet thick, but which was blown out by the explosion, together with a quantity of timber brattice above it, by which the people that were not killed by the explosion were suffocated: being aware of what I had to contend with, when I had to sink this G pit, where the late explosion happened, down to the Bensham seam, five or six-and-thirty fathoms below the main coal-seam, to avoid a similar casualty I then sunk it in two separate shafts, as represented by the plan, leaving the solid rock or stone between them; so that I calculated, in the event of an explosion, that this stone-work would resist the shock of any explosion that could possibly occur. The other is the underground brattice; it is used merely for ventilating any particular branch of the workings in which the ventilation is not carried on by double drifts. Double drifts are used in various ways, generally in critical cases three of them, two flank drifts and a principal drift, are used; but I shall probably have occasion to go into this branch of the subject more particularly afterwards. Those underground brattices are made of the thinnest materials, generally of half-inch deal, on account of their being portable and easily moved and placed in any position that is required. I shall next describe a stopping. Stoppings are made of brick, stone, or timber, as may be required. In very particular places we generally secure them stowing; they vary in thickness and

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strength, from a nine-inch brick wall to a stem or stowing 20 yards in thickness: their object is to prevent the current of air passing in the direction in which we do not require it, and to force it to pass in any other direction; for I would observe that the air always takes the nearest possible line between the down-cast and the up-cast; it is most perfectly ductile, it may be passed upwards or downwards, or in any direction, but naturally it will always take the nearest line between the points of ingress and egress, that is, between the down-cast and the up-cast. The next point I come to is trap-doors; that is a generic name, for it applies to every description of door. There are main-doors, man-doors, sheth-doors, and sham-doors. All doors are substitutes for stoppings, they answer precisely the same purpose; but they are in places where constant passage is to be made, and consequently we cannot have a solid stopping in such places. The main-doors, or first class which I mentioned, are made of the best materials, close jointed; they are fixed in jaws of brick or stone, secured in the strongest possible manner; they are all provided with strong spring snicks or latches, and there are always two of them; for the truth is that they form an air lock for the passage of the trains of rolleys, or for people passing through, as one door is always kept shut whilst another is open; but where they are of very great importance we generally have three doors. The boys are directed with the greatest care never to have two doors open at the same time; when you pass one door, the next door is not opened till the boy having let you in at one door, shuts it, and sings out with a loud voice "two;" that is the signal to the boy at the next door to open it; and if there are three, the same words pass to the third door. Those are the main-doors. I now come to man-doors. The man-door is placed in a stopping, for the convenience of the wasteman passing into the gas-pipe drifts, or other dangerous parts of the mine; they are mere traps; they are hung in the manner of a port-lid, they are 20 inches square, and are hung by hinges upon the top, so that by possibility of themselves they cannot stand open, and they are only large enough to admit a man's body to pass through them. The sheth-doors are placed in certain parts of the workings, but their intention is not to be perfectly air-tight; it is intended that they should have, generally speaking, a considerable degree of leakage, or "scale," as we call it. Then the next is a sham-door; that is, a door either half closed, or they have perhaps a deal or two left off them; they are a kind of trellis, their intention being only partially to stop the current of air. The next thing is a "crossing," that is, where the current of air crosses itself by an arch. If I found it necessary to pass a current of air through this room to go into another that is charged, or to clean it, that is to expel the gas, or if it discharges so much gas as to adulterate the air-course to the firing point, it could not be safe to bring it anywhere where it is exposed to naked lights; I then bring it back by another passage, and I cross it by an arch over the fresh-air current, and this disposes of the contaminated current without allowing it to come in contact with flame at all. I have only one other point, and that is splitting the air, or dividing the current of air, which may be done almost to any extent. My standard air-courses vary from 2,000 to 3,000 cubic feet per minute; I think the most powerful I have had occasion to employ is about 3,800 cubic feet per minute; that current of air is induced by various means, and I will now explain the modes of producing the current of air. There are various modes of inducing this current, by which the ventilation of mines is effected: the most common is by rarefaction, which is effected by placing a powerful furnace at the bottom of the up-cast pit; or where it is not safe to employ a furnace, by what is called a waterfall. Both those modes have their advantages and defects: in many instances I have experienced that no furnace could be lighted, on account of the enormous quantity of gas coming upon it, which would cause it to explode; that is an objection to a furnace, as not being applicable to all cases. The next is the waterfall; that is very good, but yet it is objectionable, because we have not the means of drawing the water out of the mine in all cases. This was the case in this unfortunate pit at Wallsend; the water could not be drawn but by buckets; therefore this mode is objectionable, inasmuch as a sufficient quantity of water could not be thrown down without risking the drowning up of the workings. To obviate this difficulty, between 1807 and 1810 I applied various modes of inducing a current of air through a mine; the steam ventilator, the hot cylinder, and the air-pump. I hold in my hand a letter which I addressed in 1813 to Sir Ralph Milbanke, president of a society established at Sunderland for the prevention of accidents by explosion in coal mines; there were a few printed; I should think it is mostly out of print, and I happen to have but one copy myself, but

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but in that all the different modes are explained. I meant no further to quote this at present than to show that the subject is not new to me, and why I refer to it is to show the various modes of inducing a current of air. The management of that current underground afterwards, is quite a different subject. Having described the mode of inducing a current of air, I will next go to the various systems of ventilation. The figure No. 1 is a diagram. [*The Witness handed in the same, which was laid upon the table.*] That is the primitive plan of ventilation in fiery collieries, when it first assumed something of a regular form. Under that system the air passes down the down-cast pit, and the Committee will perceive that the white parts round the extremity of the workings show its course, the part shaded blue represents the works of the mine which are left unventilated by that system, and which is what we call "dead waste." The Committee will observe stoppings, as was then the custom, put in at every second or third course of pillars, and marked on the plan. That was the only system known, I believe, up to about the year 1760. By this mode the air descends the down-cast pit, and it is prevented passing in the direction of C and B by a course of stoppings described on the plan, and there is a pair of double doors at A; and the effect of this is to throw a brisk current of air all round the extremities of the mine, till it is finally stopped at A by the main or double doors.

1989. The Committee observe that there are two air-courses from the down cast shaft at A, and two returning air-courses towards C and B; will you describe the object in view in leaving two courses?—Those are wide workings.

1990. What do you mean by wide workings?—All the workings are wide where we work the coal for sale; the narrow work is merely for the object of ventilation or for passage.

1991. Of what width is the wide working generally?—Four to five yards.

1992. The Committee understand that the figures 1 and 2 are the in-take drifts?—Yes, the first of the air.

1993. And Nos. 3 and 4 the last of the air?—Yes.

1994. And your experience shows that the air divided at figure 4 will in a degree take the course up No. 3?—Yes, and we can regulate that degree by slides; only No. 3 will be the weaker current: it will depend upon the area; the larger the area, the slighter the velocity. The defect of this system was, that although apparently those pits were most excellently ventilated, because the current of air had so little to do, being scarcely down the pit till it was out again, yet it leaves all the centre part, the part coloured blue, unventilated. This might extend to 40 or 50 acres, or *ad libitum*; but the Committee will perceive, that the more it is extended, the larger the accumulation of inflammable air may be, because there is no certain means of taking it off. There was a mode latterly introduced under this system, which partially obviated its defects. This was by leaving out a brick in each of the sheth stoppings, which made an opening that you might put your hand through. When the current of air was going round the extremities of the mine, the movement of people going with the horses or trams gave a bias to the course of air and forced it through the little apertures in the stoppings, by which to a certain degree the ventilation was effected, and the gas wholly or partially removed. That was called "airing by the waft of the barrow-men," indicating that the coals under ground had been formerly conveyed by wheelbarrow; for the putters or trammers retain the name of barrow-men till this day, though wheelbarrows are not now used. Under this system it was, even in the old workings, that such sudden and unexpected explosions took place, because even what they call the waft of the barrow-men frequently forced out the gas on the nearest light, at which it exploded. At No. 5 I have placed a brattice, to show the mode of clearing each particular board, chamber or gallery, of its gas; the boards adjoining figure 5 show those parts of the mine which generate the most gas, and I have put brattices into three of them, at 5, 6 and 7, to show how the gas is cleaned out of them. We have different descriptive names for the different kinds or degrees of explosion. It seldom happens that much injury arises from one of those boards, such as 5, 6 or 7, exploding. We call this sort of explosion a "flush;" perhaps the individual working in that board may be singed, but there is no general result, it goes no further. The next degree of explosion is what is called a "fire," that is if it extends to 1, 2, 3 or 4 of those boards; but if the same fire extends to a whole division of the workings, or to two or three of those sections in the back pillars, as marked "blue" upon the plan, any portion of this, without the whole exploding, is called a "heavy fire," and it generally demolishes

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the stoppings, doors and underground brattices to a certain division, but does not make an explosion or blast. It is a heavy fire underground, tearing up everything within its range, but it does not find its exit at the shaft. The next is the blast, that is when the whole explodes, and is so strong as to find relief out of the top of the pit. This was the only system of ventilation known in the coal trade up to about the year 1760.

1995. What do you consider to be the principal defect of that system?—The principal defect of this system is that it ventilated the exterior of the mine while it left the centre unventilated.

1996. What is figure B meant to represent?—The up-cast shaft, and C is the furnace. The next stage of improvement was invented about the year 1760 by Mr. James Spedding, of Workington, one of the most able pitmen of his day; I use the word "pitman" in contradistinction to collier. If a man comes to me for a situation as overman, or any other situation of responsibility, my first question is, "is he a regular-bred pitman?" We speak of a good pitman as we would do of a good seamen; that is to say, he must understand all the various systems of ventilation thoroughly, both in theory and in practice, and I always subject him to an examination, if I do not know the man myself. A collier is a man who works the coals; therefore we have a middling good pitman, a thorough good pitman, and a pitman; which latter are the highest degrees. Mr. Spedding, I consider, from all I have heard of him from tradition and what I have seen of his works, to have been the first pitman of his day. Mr. Spedding, seeing the defect of the plan No. 1, that it did not effect a complete ventilation, it occurred to him that the only way to remedy that defect was to make the whole of the workings air-pipes, called coursing the air, as I have described. The current of air is taken from the down-cast pit, and then traverses up and down the several sheths of the workings, so that no particular gallery or working is left without a current of air in it; by which he succeeded in expelling the gas from all the workings.

1997. The current of air so thus distributed would be very slight, would it not?—It is not so much divided or diffused as to produce this effect; it is put in at one end of the pipe and is discharged at the other. Before I adopted my own system I had known the air led through a pipe or series of workings of upwards of 30 miles long before it made its exit.

1998. Does not that plan subject you to much inconvenience from interruptions and falls?—Not very much; as we have a set of men who constantly travel the workings, called "waste-men," because they travel the waste.

1999. Whose business it is to keep the air-courses open?—Yes, their sole duty; and it cannot be done without those men know anything about the pit. The moment almost that an experienced person goes down a pit, he can tell by a certain criterion, by which he can judge, whether the ventilation is in a right state from the double doors at A in Plan 1. If any interruption take place here to obstruct the air-course, the air must naturally press by the nearest passage to the furnace, and it seeks to relieve itself at every crevice it can find. Hence we hear the stoppings, as we call it, "calling:" if an interruption has taken place anywhere, the stopping to the right of A would begin to sing or call, that is, would give indications of an interruption in the air-course, and so would every stopping in the same line towards the bottom of the plan, and the doors at A would make a whistling noise; and the instant such an effect is discovered, the party discovering it calls "Holloa, there is something wrong, the doors are calling!" And again, there is another indication; the boys cannot work the doors so well, they get so heavy. I think we have now arrived at a sufficient knowledge of Mr. Spedding's system of more complete ventilation, which consists in forming, generally speaking, every passage of the workings into an air-pipe. The defects of his system were the return of the air, all coming in one current to his rarefying furnace on letter C; whether it was at the explosive point or otherwise, it must come there. Then to obviate the danger arising from the explosive mixture at the furnace, we adopted what I have termed the "waterfall," by extinguishing the furnace; I have many a time had to put out the furnace on a very short notice.

2000. Lest the gas should be inflamed from the furnace?—Yes; I have known it fired from the furnace. I have known many explosions from the furnaces on the surface through tubes, as well as under ground; therefore that system was not perfectly safe; there was no certainty in it, it depended upon the state of the "return."

2001. That is to say, if the works were so extensive as to bring down a sufficient

cient quantity of impure air to the furnace to form an inflammable mixture, an explosion would take place?—Yes, we have no control whatever over it; all that we could do in that case was to extinguish the furnace and set on a waterfall at the down-cast pit, and pour a quantity of air down till the discharge of gas subsided, or until some different arrangement was made. I remember on one particular occasion watching almost daily a furnace for about six weeks before I got it lighted, at Hepburn colliery, and was only able to do so by taking advantage of a favourable state of the atmosphere.

2002. You forced the water down to produce a current of air downwards, instead of driving the air up the pit?—Yes; in the pamphlet to which I have alluded, plate 2 is an illustration of that plan. The relighting the furnace was sometimes so critical an operation that we durst not trust ourselves to light it by hand; we therefore ran a line from the top of the shaft, and left it slack through the passages leading to the furnace; it was then tied to the bar of the furnace, and tar and various combustibles put on; then we slipped a red-hot iron ring down the line to the combustibles, and this lighted the furnace. This system was the only one we knew of, and the only one that was pursued up to about the year 1807, I believe. I had turned my attention to this subject very much; I had at that time very full occupation in the most fiery mines in our district, and seeing the defects of this system, I was extremely anxious to find out some way or other of improving it; I turned my attention to the subject, and I did devise a mode of obviating in a considerable degree the defects of Mr. Spedding's system, but it was some time before I got it fully into practice, because it was not in accordance with the views of many of the old and experienced pitmen. They had a horror of dividing a current of air, inasmuch as they thought that each division or split would weaken the principal current; however I tried some experiments which convinced me to the contrary. The next in order to Mr. Spedding's, is what I am about to describe. Let A be the down-cast, B the up-cast, C the furnace, and D the dumb furnace.

2003. What do you mean by the dumb furnace?—The furnace that is not lighted.

2004. Will you explain your modifications of this plan?—Previous to this complete separation of the currents of air, what was called "scales" had been admitted; this is a scale, for instance, if at A a partial division of the current of air is made; but my system goes to an entire and complete division of the circulating current. I will now describe it. I divide the main current into two separate streams at the bottom of the pit A; the body of air coming down the pit is divided, as will be seen by the direction of the darts, which show that the course of the currents of air take through in the same manner as by Mr. Spedding's system, as my system only consists in dividing the main current of air into two distinct currents. It will be seen that these black darts represent that part of the pit in which the course of the current of air is not rendered explosive, but is free from explosive mixture.

2005. The principle of your plan is, that one current of air should carry the air which is not explosive through the furnace, and another current of air which is liable to become explosive out of the pit, without going to the furnace at all?—Yes.

2006. So that the explosive current of air should not mix with the other current which is not explosive?—Yes; I have explained that what is called the clean current, though it cannot be considered as absolutely clean, for even when there is 1-30th part of the mixture of carburetted hydrogen, it indicates on the candle its presence. The current designated by the blue darts is that which is subject to be loaded to the firing point, and they show how it approaches letter D, and is discharged through the dumb furnace.

2007. Communicating with the up-cast shaft B, out of reach of the flame?—Yes, at a higher level. This has also been described in the small work to which I have alluded, in figure No. 6. That shows the general principle, but the Committee will be aware that that is subject to modification and alteration in various ways. For instance, I could lay any portion of the workings, by proper alterations in the stoppings and doors, which may be safely trusted to the furnace, or I could add any portion of the workings or waste I please to the vitiated current, so as to come through the dumb furnace at D; so that, if I found it necessary, I could confine, by proper arrangements of my furnace, all the adulterated current to a mere gas-pipe or drift, so as to pass through the dumb furnace only.

2008. Has not the effect of these improvements been to extend the quantity of

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ground which may be worked in the same pit or pair of pits?—No; it has sometimes happened; we have some collieries with only one pit.

2009. Supposing that there was a single shaft as formerly, does it not follow that a smaller quantity of ground could be worked in the same pit?—There are many collieries that could not be worked to advantage without having more pits than one.

2010. In case of anything happening to the stoppings, so as to prevent the complete division of the air, has it not increased the danger of explosion?—It has not; in more than 20 years' practice I have not known an accident from this cause.

2011. Supposing both currents were to go to the furnace, does not the extension of the quantity of ground which has remained for ventilation increase the danger of explosion?—I should have supposed it might; but after 20 years' full experience of this, I have had no explosion.

2012. Would not the consequence have been this, if you had not introduced this, that a smaller quantity of ground would have been worked on the same number of pits; because if so large a quantity as is now worked had been worked at the same pits, the quantity of gas would have raised the explosive point?—It is true, but in the course of my evidence the Committee will see how that is disposed of; and where a pit costs from 10,000 *l.* to 20,000 *l.* sinking, we cannot afford to sink a shaft in every 10 or 20 acres.

2013. Then, independently of the expense, it would have that tendency?—It would; still it would not prevent accumulations of gas, as the Committee will see. My system consists in having a gas-pipe or discharging drift, and a safe ventilating current at the same time.

2014. You have already described that it is within your power to detach those portions of the mine in which there is a great exudation of the gas, from those parts which require no such stopping?—Yes; and we are continually making changes, borrowing and lending, sometimes laying one division or pannel upon one air-course, and sometimes upon the other, just to suit the immediate occasion.

2015. That is to say, if in working a section of the mine you found that the exudation of gas had diminished so as to become no longer dangerous, you would transfer it from the contaminated air-course to the pure air-course?—I would; and for this reason, that I could then introduce candles into a larger portion of the mine in lieu of Davy lamps, and I should have the further advantage of being able to use gunpowder, which I could not otherwise do.

2016. It is always an object to watch the mine, so as to keep as large a quantity ventilated as possible?—Always as large a portion as we can. So far as I have gone, all this is comparatively easy, as it applies to the working, or working of the whole mine, as it is called, and we conceive that we can place those workings in a state which guards us effectually from explosion, except from causes which we cannot control, the proximate causes of which are here described, in a paper which I wrote for the Natural History Society of Newcastle.

2017. You hold in your hand a printed account of the explosion which took place in Jarrow colliery on the 3d August 1830, written by yourself, and which was read at a meeting of the Natural History Society of Northumberland, Durham and Newcastle-upon-Tyne, October the 18th 1831, and published in their transactions, and again in this separate form, printed at Newcastle, by T. and J. Hodgson, Union-street, in the year 1831?—Yes, the causes of explosions are briefly stated in that work.

2018. You refer to this work as a practical exposition of the causes of that explosion?—Yes, of that in particular, but of explosions in general.

2019. This also will illustrate the general causes and attendant circumstances of explosions?—Yes.

2020. You have alluded to some of the difficulties which supervene in mining after the whole coal has been wrought to a certain extent?—I have: during the working of the whole coal I consider there is very little difficulty. Our difficulties only commence with the working the pillars; comparatively, it is almost child's play till we come to the working of the pillars. [*The Witness produces diagram No.* 3.] This is the same set of workings represented in this diagram as in the two preceding diagrams, but in the state of pillar working. The Roman capitals upon this plan designate precisely the same stations and parts of the mine as upon the preceding diagrams; and the part marked blue represents the part where the working of the pillars has commenced, at the southern extremity of the mine. Before the working of the pillars commences, it is quite clear that the ventilation

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tilation of the several passages, or boards, &c., may be kept perfect, supposing the working extended no farther than A and B. It will be seen, that so long as we have pillars standing, we can convert every one of those passages into an air-pipe, and command a current of air as we please, either to the burning furnace, or the dumb furnace at C and A, as occasion may require. But it will appear obvious, that having come to an extremity or boundary, and it being necessary to begin to remove the pillars, that the first pillar that we take off deranges the ventilation at that point, and we have no means of carrying the air into the point at C, which was formerly a pillar in the mine; and we proceed to take off the pillars of coal, always working to the windward, that is to say, against the stream of air, in order that whatever gas may be made, may be immediately carried off from the people working then. When we have taken off a range of pillars, as at D, E and F, and so on, we have no power of dislodging the gas from the wrought section of the mine, except at A and B: and still, as we proceed to the northward of the mine, we daily increase the size of this goaf or void, which may be termed a gasometer, and the gas exudes from it at G, H and I, into the circulating current, which is discharged by the gas-pipe drift at the dumb furnace, and is never suffered to come in contact with flame of any description. The next range of working is the line of pillars at the north of A and B.

2021. Upon this plan the coal is entirely cleared out of the blue space?—Yes.

2022. Has it ever occurred to you to consider whether the mine might not be so worked as to clear the coal out completely at once?—We have worked it in this manner; but still we are subject to the same discharge of gas, because we still have to leave the immense void behind us, forming a gasometer.

2023. The roof in that case would fall behind you?—Yes, always; but then it does not fall solid; it falls down, and leaves an immense quantity of interstices, which form the gasometer: and worst of all, (for it is not merely the gas that comes from the Bensham seam itself), but the chief mischief is, that in working off the pillars, the roof is fractured up to the next seam of coal, called the "yard coal seam," which abounds in gas, and brings it down in large quantities from that upper seam, and thereby keeps this enormous gasometer continually charged.

2024. Have you ever tried the experiment of working a mine upon the principle which has been alluded to?—Yes, and the principle upon which I am working this unfortunate seam is a mixed one, as it in a considerable degree embraces the view of the subject named in the question.

2025. Were it not for the cracks in the upper seam, the quantity of gas that would be made where the pillars were removed would be very small?—Yes, excepting when an eruption takes place from the thill, or pavement.

2026. The whole of the coal in which the gas exudes having been removed?—Yes; but the gas does not confine itself to the coal; it comes from the bottom also as well as the roof.

2027. That bottom being a carbonaceous substance?—Yes; but there are other very fiery seams below this, and the gas probably exudes from them upwards. When a pillar is partially worked, and sustaining the whole pressure of the roof, before the roof breaks eruptions of gas take place from the bottom, which joining the quantities of gas discharging from above, continually keep the gasometer charged; so that we cannot pretend to ventilate the space coloured blue; we cannot do that. All that we can do, or hope to do, is to carry off the gas as it exudes from the waste or gasometer, by the current of air, as described by the line of darts on the diagram, to the dumb furnace.

2028. Will you proceed to give the Committee some idea of the quantity of gas occasionally generated under the circumstances which you have described?—I should beg to refer to the plan of the colliery at Wallsend where the accident happened lately; the diagrams which I have described may be considered as illustrative of the principle I am now coming to explain on the working plan of the Wallsend colliery where the unfortunate accident on the 18th happened.

2029. In describing that plan, you have pointed the Committee's attention to certain shafts in which the contaminated air or carburetted hydrogen is conveyed to the surface in metallic pipes; have you ever gauged the emission of those pipes?—Yes.

2030. Will you state your calculations?—My calculation is that the discharge from those pipes is about two cubic feet of gas per second, from an area of five acres of the mine, out of which the pillars have been worked from those two divi-

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sions here represented. That is the whole collection that would pass along the air-current, if it were not taken out of the circulation by these means.

2031. This is independent of that, if not imperceptible, at least not dangerous mixture which goes into what you call the air-course?—Yes, it is totally abstracted from it.

2032. Have you ever had any opportunity of personally judging of the nature of those eructations or eruptions which arise from the floor?—Yes.

2033. Do they equal in vehemence or quantity the ordinary blowers from the roof or side?—They are generally more copious for the moment, but they are more transient; it is literally an eruption, and soon goes off.

2034. The Committee observe that in the map laid before them, you have divided the mine into compartments, which are specifically marked as districts, north-west and south-west, 1 and 2, &c.; will you state to the Committee the object which you have in view in working the mine on that system?—With a view to render it more safe, as I have experienced; in the event of an explosion taking place in one district, that it may not communicate with another; it is to divide the risk arising from explosion.

2035. As the mine described upon the plan is a very fiery mine, you adopt that system as a precaution?—Yes.

2036. Is there no communication whatever between those districts?—No, no air communication, generally speaking; what we call "separations," in our acceptation of the word, mean that the currents of air in the different districts are separated. I would observe that the whole extent of workings in the Bensham seam are very little above 100 acres, and that for the ventilation of that area there are three down-cast shafts and two up-casts.

2037. The Committee understand that the plan before them covers a space of 100 acres?—The present working part of it; it covers more if you include the exhausted part, but the whole together is not above 120, or 130 perhaps.

2038. Do you consider that the proportions between the up-cast and the down-cast were such as your experience would have led you to consider proper for the working of that mine?—Yes; I have always found them efficient whenever I have examined them.

2039. If you had been able to force a larger quantity of air downwards, would not that have secured a superior ventilation?—It would; but I think it would have been more than necessary for the occasion, for too much ventilation is troublesome; even in that pit it was so much that the "hewers" very frequently complained of it being too much for their candles, it melted their candles too much, and they frequently set the board-end doors open to slacken the current of air.

2040. You think that the late accident occurred not from any deficiency of ventilation, but from the man going into the waste part of the mine?—Yes, I give that as an opinion from the appearance of the mine; and from all that has been discovered, we are satisfied that it has not taken place in any of the working divisions.

2041. Might it not happen from the ventilation?—Yes; but we have it from the coroner's inquest that the ventilation was good.

2042. Were the men working with candles?—Yes, in two of the divisions.

2043. At the point where you suppose the explosion took place?—Yes, but this is not in any of the working divisions; two men were blasting down the roof to make horse height on the rolly-way, but the air was clean in this part.

2044. You have stated that near to the point where the men you have mentioned were at work, there was a man-door?—Yes, a man-door for the convenience of the waste-men getting into the gas-pipe and coming from it.

2045. Is it not the custom of the waste-man to lock the door after him?—It is in all the frequented parts of the pit where there is any chance of any unauthorized person getting to those doors; but we have had the locks stolen off those doors frequently.

2046. Within what distance of the door that you have named was the work connected with the railroad going on?—About 40 yards.

2047. Supposing by accident that man-door left open, would the rest of the mine have had a communication with any waste beyond that door?—Yes, with the exhausted districts on the south side of it, and on the south side of the gas-pipe drift.

2048. Can you suppose a pressure in that part of the mine which would force the carburetted hydrogen through the door either left open or disturbed?—Yes, it is

is possible; we have tried how the air preponderated, by setting that door open to see what would be the effect experimentally, not to incur any danger. That door has been set open to see how the currents were balanced; the currents were running parallel, being separated by a coal wall between them; setting open this door showed which current preponderated; I have had the doors set open to examine whether one or the other had the balance: we always hear by the singing of the door if there is a balance or leakage, which there should by rights be from the current of fresh air into the gas-pipe drift; generally speaking, they have been very nearly balanced, and rarely indeed has the gas preponderated and come into the fresh air.

2049. In point of fact, this man-door formed a private communication between the pure air-course and the foul air-course?—Yes, for the convenience of the waste-men passing through to examine the state of the gas-pipe drift.

2050. Do they always use the Davy lamps?—Yes, they travel this constantly with the Davy lamp.

2051. Can you conceive the workman you have named led by curiosity or for any other purpose through this man-door, in case he discovered it was open?—It is possible he might; he might have laid his provision there, because within the place against the door it is a sort of closet, and it is by no means an uncommon thing, when the men are working in those situations, to make use of the recesses leading to the doors as a kind of closet to deposit their tools, to keep their gun-powder bottle in, and to put off their upper clothes in; when they are going to work, they very frequently do so.

2052. Was this man an experienced miner?—He was.

2053. An inquest has been held upon the bodies that have been taken from the mine?—Yes, it finished on Monday.

2054. What is the result of that inquest?—I had a letter from a friend this morning, which is a copy of the inquest.

2055. Were all the circumstances of the case very fully investigated?—I think as fully as possible.

2056. What is the verdict?—Accidental death. I was first examined to explain the system of the ventilation. I referred to the under-viewer and overman for the daily details, and I gave a general invitation to all the workmen to come, whoever chose to give evidence, to explain all that they possibly could, and several of the workmen were examined.

2057. In case the Committee have the minutes of that inquest laid before them, they will contain all the information relative to this catastrophe that it is in your power to give?—It will; I can give no more facts, I can only conjecture.

2058. Were you called upon to account in the way of conjecture for the accident, before the coroner?—I do not think I was specifically called upon to account for it; indeed, when the inquest commenced we were in a great degree under the idea that it originated in the eastern division of the mine.

2059. From your latest consideration of the facts which are now before you, can you state your present impression as to the immediate cause of the accident?—Yes.

2060. Will you furnish the Committee with a copy of the portion of the large plan now before it, which would completely illustrate the views which you wish to lay before it?—I do not see how I could. The Committee will be aware that it is the practice of the pitmen, when they have any doubts as to the safety of a mine, to take the opinion of disinterested viewers, or, as they term it, to call a view. They say, "This is not a safe colliery, and we will have the opinion of some person upon whose judgment we may depend, as to whether this is a safe pit or not." Had I had nothing to do with the colliery in question, and the colliers had appealed to me for an opinion, and to go down the pit on their part and examine this mine, I should have reported to them that I found it a perfectly safe workable mine; that is our expression, always with this reservation, that we know there are two points of danger solely depending upon the safety of the Davy-lamp, and that there is no possibility of an accident happening, barring accidents by the Davy-lamp, or by some person negligently, wilfully or inadvertently setting the gas on fire by going to some place where he ought not to go.

2061. The under-viewer had examined the colliery about five or six hours before the accident occurred, and had given you that report?—Yes; John Atkinson, the under-viewer, and one of the waste-men, actually entered the gas-pipe that morning,

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ing, and travelled it all the way to the west of the shaft, from the east extremity of the workings to 100 yards west of the G pit shaft, making a distance of 600 yards.

2062. Was the report of the under-viewer to you that he had actually travelled the waste, given before the accident had occurred?—Yes; I had been absent from the Saturday preceding, and I was very anxious to know the state of the mine.

2063. Is there a record made of any report by the under-viewer?—No, it is a verbal report; it is a matter of conversation, perhaps three times in the course of one day, whenever I meet him; but always once a day when I am at home.

2064. On the morning in question what was his reply to your usual inquiry after the state of the pipe?—He said that on the 17th a discharge of gas had taken place in the eastern division of the pillar working, which filled the Davys with fire, and that the overman found it necessary to withdraw the men for three quarters of an hour. We do not, though we have no apprehension of fire from the Davys, think it prudent for the common men to work for any length of time with their lamps red hot; but as regards the overmen or wastemen we do not interfere with their travelling in the foul drifts, but their own discretion is their guide. The under-viewer further reported that he went on the morning of the 18th, at two o'clock, to examine the same part of the mine, and that he found it better than usual, and no part of it explosive. On these points I beg to refer to the evidence of Messrs. Atkinson, the under-viewer and overman, as taken before the coroner, whose minutes I understand will be laid before the Committee.

2065. Have you sufficient information to enable you to judge in what part of the mine the accident originated?—Yes.

2066. Can you give the same testsmony as you gave before the coroner upon that point?—No; I am not aware whether my examination went to that point.

2067. Have circumstances come to your knowledge as to the way in which the accident originated?—Yes; but I was in hopes that I might verify my ideas upon this subject. I think if I was at the mine, I might discover something which would lead to absolute certainty.

2068. Your opinion is, after examination of the colliery, that the accident occurred from no deficiency of ventilation, but from what might occur in any colliery?—Yes; we are at the mercy of any person unscrewing the Davy; that man, who we conjecture had fired the gas, might be going there upon a private occasion.

2069. And you think, that if the same ventilation as before the accident were in operation in that mine, it might be carried on with perfect safety?—It has been carried on for 10 years without accident; and the most distressing part of the accident is, that if to-morrow the mine was placed in an equal state of safety, the following day, and even the following hour, we are subject to the same casualty; that is the most melancholy part of the business. I pronounce the mine to be, in the common acceptation of the word, in a safe state.

2070. And it would not be in your power to put that mine in a better state of ventilation than before?—No; all that I can do is to preserve one or more currents of pure air for candles, and to carry that from the divisions which discharge gas away in a separate channel.

2071. Is it safe to use candles at any time?—Yes; I consider it a very great protection the using of candles.

2072. Will you state what you mean by that?—It keeps every man upon the alert; we never can by the use of the Davy-lamp judge of the quantity of air passing, so well as we can do with the candle.

2073. How do you do with striking with the steel?—We never use it now.

2074. You have described an improved method of your own for ventilating mines; that is the method at present in use in the north of England?—It is; I invariably practise it myself, and I believe it is becoming now pretty general, because the advantage of it is so very evident.

2075. Have any suggestions been made at any time to you, as to the possible improvement of that system?—No.

2076. Have any occurred to your own mind?—No; it is from the quantity of air passing that we judge, and we know quite well that whatever the quantity of gas discharging from any one particular point may be, we must mix at least 15 times the volume of atmospheric air with it, to dilute it below the firing point. From 14 to six is the range of explosion, but to make it quite safe we must have 15 parts of atmospheric air to one of carburetted hydrogen.

2077. Is it a frequent practice of the men to leave the working of a colliery because it is not safe?—It does sometimes occur, but not often.

2078. And

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2078. And is it the case frequently for a viewer to interfere between the viewer of the colliery and the men?—Yes; that is a privilege they have always, and it is never denied them.

2079. And there is no difficulty made by the proprietors?—No.

2080. But it does not often occur?—No; the colliers choose one viewer, and the owners the other.

2081. With the present system of ventilation and the use of the present lamps, do not you think that it would be possible to put the Wallsend colliery in a better state than it was before the accident occurred?—No, I do not know how I could do it; I am quite certain that the quantity of air put into those pits would not be less than 5,000 cubic feet of atmospheric air, put down in a minute.

2082. How many pits?—There are three down-cast shafts and two up-cast.

2083. Do you agree in the opinion given by some persons, that the deeper the mine is from the surface of the ground, the better the ventilation is?—No.

2084. Are not the facilities for ventilation greater?—I do not know: all the advantage, I conceive, in this case must be the preponderance of the column of cool air; it is a greater column of cold air, and of course you may have at the same time a greater column of rarefied air, which is so far an improvement.

2085. Do you think the draft of the upgoing shaft is increased according to the square of the depth of the mine?—I have no means of knowing that, because it is not depending upon the pit itself, it must have the aid of artificial means. Supposing two pits upon an equal level, the weight of the atmospherical column is equal on both, and no preponderance will take place either way; the current of air is altogether dependent upon the difference of temperature in the two pits.

2086. Is not the quantity of current caused by the rarefaction?—Yes; but it is altogether a question of temperature.

2087. That temperature has an effect upon the density of the air?—Yes; and if we have a column of 200 fathoms of heated air and 200 fathoms of cold air, according to the first principles, the column of rarefied air should be nearly twice as powerful as it would be in a 50-fathom pit.

2088. Evidence has been given that in the ascending shaft of the mine, the velocity increases in the same proportion as the velocity of falling bodies?—I have never measured it; nor do I see that it is referable to the law of falling bodies.

2089. Is not the accumulation of velocity in the pit in comparison to the height of ascent?—Yes; it is tantamount to the longer leg of the syphon; there is a longer column of hot air created by rarefaction, consequently the impetus must be increased.

2090. You have produced a diagram, showing a plan of the workings of the Bensham seam at Wallsend colliery, at the time the explosion happened, on the 23d October 1821, where it is reported that 52 lives were lost; to what extent had those workings been conducted at that period?—There was not one place in the pit 100 yards from the bottom of the shaft.

2091. As this shows to what an awful extent such a catastrophe may occur in very limited workings, will you state the particulars of that accident?—Yes. I must commence a little before the accident, just to explain the nature and circumstances of the mine previous to the accident taking place: that was an experimental pit; the Bensham seam was unknown in this colliery till that pit was sunk to it.

2092. The Committee understand, that previous to the commencement of the workings of the Bensham seam, the upper seam, called the main-coal, had been wrought to a certain extent?—Yes.

2093. And you afterwards sunk at the pit at A, which had been previously a main seam, a shaft down to the Bensham seam; and then the shaft was bratticed, the down-cast being on one side of the brattice, and the up-cast led to the shaft B in the main coal, where the furnace was placed?—Yes; at the bottom of which a furnace was placed.

2094. Will you proceed to state, under that mode of ventilation, what further measures were taken for ventilating this mine?—Little more in fact had been accomplished than holeing round the shaft; that is, sufficient work to obtain a free communication of air in the vicinity of the shaft: in the state the workings were on the day before the explosion, the brattice is designated by red lines, showing the run of the air through the workings; the air descended one side of the A shaft, the first stroke, as it is termed, was to the bottom of the shaft; to prevent the air slip-

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ping to the eastern side of the workings which have been commenced, a door was put in, and it was carried along by the brattice due north and into the first west board, and so on successively through all the different working places, as the darts designate, till it was again cast upward on the other side of the brattice. I found the seam prodigiously fiery, so much so that the coal itself afforded gas enough to light the pit.

2095. Was that independent of any particular fissure or brack?—Yes; I simply drilled a hole into the solid coal and stuck a tin pipe into the aperture, surrounded it with clay and lighted it, and I had immediately a gas light; the quantity of gas evolved from the coal was such, that in every one of those places I had nothing to do but to set a candle, and then could set a thousand fissures on fire; the whole face of the working was a gas-pipe from every pore of the coal, and when the shots were fired for blasting down the coal, they generally set fire to the gas as it was evolved from the coal. The men had what we called dusters or wet sacks on their jackets, by which, as soon as the gas began burning, they knocked the flame out, but sometimes that might not be sufficient, and in this very pit I had in the main-coal seam two cannons, because I found concussion the best mode of putting out flame, when inaccessible to dusting.

2096. What size were those pieces?—I had them made of a peculiar construction; they are made of malleable iron, and the bores are conical, about two inches and a half in diameter at the muzzle; the depth of the barrel is not more than 14 inches, and we charge them the same as charging a shot, that is, we put in a quantity of powder and stem or tamp them with oakum driven down by a heavy maul, the object being concussion.

2097. What quantity of powder would you insert?—I should suppose about half a pound, from a third to half a pound.

2098. And this you have found successful in extinguishing fire?—Yes, I have extinguished gas fires that were not accessible by any possible means; it is a thing which I think ought to be generally known, because the immense concussion will knock out the flame of inflammable air when it is not accessible. I have succeeded in the top of one of those gasometers when the flame has run into the goafs or wastes, by explosion of one of those guns, and have thus shaken the flame out. My under-viewer performed a very clever feat some months ago in the Bensham seam at Wallsend; I gave him the highest credit for it: it occurred in a stow-board.

2099. What do you mean by stowing board?—A place to deposit rubbish in, to avoid the expense of bringing it up the pipe; we were making a railroad between two dykes, which required the blasting down of the roof.

2100. That is to obtain head room?—Yes, for the horses, and also for the deposition of rubbish from several adjacent parts of the mine. It was being put into the stow-board; the brattice for the ventilation of that stow-board was kept close down to the face, and only withdrawn as the rubbish filled up the place. The current of air was passed along one side of the brattice, and returned round its end and up the other side as usual. The Davy-lamps were used by positive orders during the stowing up of the board; however at last, when the stowing had arrived at the outer end of the stow-board, and of course all the brattice had been taken out and the board nearly filled up, the stower came with his candle too near to the stones or end of the stowing; the gas oozing out of the stow-board from amongst the rubbish, caught hold of his light and filled the interstices of the stowing with fire instantly, although there was a full current of air passing the board-end at the same time. It blazed furiously, and they could not get access to it; it was blazing out all across the place: it was about half-past two in the morning; I was called; the under-viewer had gone down, and he sent his son, the overman, to tell me the dilemma they were in, and wished to know what was to be done. The first thing that flashed across my mind was, if possible, to get part of this stowing taken away in the face of the fire, hoping to put in an air-tight stopping at the very entrance of the stow-board, so as to extinguish the burning gas by preventing the access of air. I made the best of my way to the place, and when I arrived within a very little distance, I met some men who gave me the welcome intelligence that the fire was out. I came up to the place, and found a great quantity of smoke as I approached the place, and the men that were working in the current of air to leeward had been driven out by the strength of the smoke and after-damp. This fire was about five yards broad, and came flashing out of the top of the stowing, and the flame was playing backwards and forwards, sometimes apparently out, and then re-appearing again. When I came, I asked Mr. Atkinson, "how have you managed

managed this?" and he said, "I knew the guns were not at hand, and I drilled a large hole into the rock on the right hand of the board, and made a gun of it." He put a large charge of powder into this hole, and about half stemmed or tamped it; he then exploded it, which produced the desired effect, as it instantly extinguished the flame. I gave Mr. Atkinson very great credit for his tact on this occasion; it showed great knowledge and judgment of the subject, and he effected by this expedient what there would have been great difficulty in accomplishing by any other means.

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2101. And this you instance as a great proof of the advantage of sudden concussion in similar cases of explosion?—Yes, in extinguishing flame.

Jovis, 2° die Julii. 1835.

JOSEPH PEASE, ESQUIRE, IN THE CHAIR.

Mr. *John Buddle*, called in; and further Examined.

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2102. AT its last meeting the Committee took the opportunity of asking you some general questions upon the subject of ventilation; has anything occurred to you to add upon that subject, on referring to your evidence of yesterday?—I do not recollect anything; there are a thousand modifications of the system, which would furnish an essay in fact, but which I think it is scarcely necessary to go into.

2103. But the evidence you have given has, in your opinion, embraced all the essential points as connected with the system now pursued in the north of England?—Yes.

2104. The dangerous part of the working of a colliery commences with working the pillars?—Yes; I mean to say that the mine is then placed under circumstances beyond our control, so far as ventilation goes, inasmuch as we cannot ventilate the workings where the pillars have been removed.

2105. You were asked as to the different modes of working mines; you are aware of a principle of working mines by long wall?—I am.

2106. You stated that you had tried the experiment of so working the coals in the north, and that you found it did not answer?—Not in all cases; I found it answer in some cases; but so far as I speak of it in reference to ventilation, there is no advantage from it, because the ultimate object of all coal-mining is to get the utmost produce of the mine; and therefore if we remove all the mine, or the greater portion of it, whether by the system of long wall or short work, we still arrive at the same result, namely, a large void which cannot be ventilated.

2107. Suppose the two states of a colliery, the second commencing when you begin to work the pillars, what proportion does the coal left bear to the coal which has been raised at that period?—It depends entirely upon circumstances; the pressure being (I speak now simply of the pressure independent of the tenacity of the strata) in the direct ratio of its depth, consequently if the stratification of any district is perfectly similar, it follows that a pit at the depth of 50 fathoms requires only one-half the support for the roof that one of 100 fathoms would do, that is as regards pressure only; it is in the direct ratio of the depths.

2108. Then you proportion your pillars according to the depth?—Yes, and according to the nature of the strata.

2109. Of the roof and floor?—Of the superincumbent strata from the roof of the mine up to the surface, whether it be 100 or 200 fathoms.

2110. The Bensham seam is considered to be the most dangerous?—Yes, it is. Perhaps the best mode of explaining this matter will be by a practical illustration of the modes of working the pit in question: I have tried various plans in the working of this coal with a view to obtain its maximum produce in the safest manner. The general outline of the plan which I have adopted is by laying out the field of coal according to what I call pannel work, a system of working which I adopted prior to the invention of the safety-lamp. I tried to obtain the maximum produce without the working of pillars at all, that I might avoid the dangers to be apprehended from making "goaves," which could not be ventilated.

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2111. With an intention of sacrificing what was left?—With the intention of sacrificing as much pillar as would barely support the roof of any one pannel or division, or district, so as to keep the ventilation perfect till we had got our maximum produce of coal out of it. I think I have a minute of the produce under the different circumstances. The maximum produce which I could obtain under a perfect system of ventilation was 48 per cent., consequently 52 per cent. was sacrificed in pillars. The next system I tried embraced the principle of long work, generally called the Lancashire system; it succeeded very well so far as regarded the obtaining of the greatest quantity of the mine; but it brought another evil upon us which more than counterbalanced the advantages resulting from that mode of working; in fact I may say that it induced a double mischief: the first was the increased quantity of small coal produced, as there was an incessant pressure and grinding upon the walls which crushed the coal exceedingly, and caused a great produce of small coal which was of no value; but the chief mischief attending it was the breaking of the strata up to the yard coal-seam, which I have already described, and thereby bringing upon us a double supply of gas. Having failed in this experiment, which I tried to a sufficient extent, for the reasons which I have stated, it then occurred to me that something like a middle course would be best. I therefore adopted a system to induce a bending of the roof, but not a breaking of it, which for a considerable distance up, as will be seen by the section, consists of what we call metal stone, or what is called, in many parts of the kingdom, plate, clod, blaes, and various other local names. It possesses a considerable degree of tuftness, or tenacity, and bends very considerably under certain circumstances, with only slight exfoliations, which may be supported by propping in a temporary manner; and as the pavement also yields a little, the two by degrees approximate and produce what we call a creep, or gentle settlement; by this I hoped to avoid the breaking of the roof, and the bringing down of the gas from the upper seam, nine fathoms above, at least in such enormous quantities as came down when the strata was completely broken. Those two divisions of the workings which I referred to upon the plan yesterday are both worked in this manner to the extent of some acres; and so far, I have reason to believe that it has been successful, at least it seems a more advantageous mode of proceeding than by the former modes.

2112. The principle you are now describing is the mixed system between your own and the long wall?—Yes, between our short-work and the long wall; it is an intermediate plan. By the long-work I should think we might have obtained nearly 90 per cent. of produce, but much of that was left below on account of being so much crushed; we could have brought it up if it had been a saleable article, but it was so excessively crushed that it would not pay for bringing out.

2113. Had it not a very bad effect upon the coals sent to market as a merchantable commodity?—It had. Upon this intermediate plan we obtained 63 ½ per cent.

2114. That is by a combination of the north-country method and the Lancashire method of working, so as to obviate those great discharges of gas of which you have spoken, and the deterioration of the quality of the merchantable coal?—That is precisely the case.

2115. You have therefore given the preference to the last-named method over the two preceding?—Yes, inasmuch as hitherto it has proved successful to the full extent which I had contemplated.

2116. If you had no fear of accident from explosion, do you conceive yourself in a situation to remove the whole of the coal out of the mine?—I think about 80 to 90 per cent. of it.

2117. Then presuming the mine to continue in working, 63 ½ per cent. is the greatest quantity you can take with a due regard to the safety of the men engaged?—Yes, under all the circumstances already stated.

2118. Do you apprehend that any further protection would be afforded by reducing the quantity below 63 ½ per cent.?—I should think it would, inasmuch as it would further tend to prevent the breaking of the roof; but I could only then go back to the former system, by which 48 per cent. was obtained. If I am to avoid any alteration in the roof at all, by either bending or breaking, I can do nothing else than go back to the system by which I can only obtain 48 per cent.

2119. How much per cent. is obtained in the coal mines in Wales?—In many cases you get the whole.

2120. The plan pursued there would not do in the north?—We adopt it in some cases; there is no variety or mode of working almost that we do not resort to as circumstances may require; we adopt any system that may be applicable to the particular case. Some of our mines I have worked entirely by the Lancashire method, where it was proper to do so. I must beg the Committee to bear in mind that the ultimate object of all coal-mining is to obtain the greatest quantity of merchantable coal from the seam.

2121. The adoption of the long-work system depends very much upon the thickness of the vein, does it not?—Not altogether; it is confined within prescribed limits, depending upon a variety of local circumstances, as the nature of the roof and a thousand other things, that there is no general rule for it, but every one working mines must be left to the exercise of his judgment and experience; there are so many collateral circumstances to be taken into consideration, that you cannot lay down any general rule.

2122. You described yesterday a loss of life in one section of the work being occasioned in a great measure by the blowing away of the brattice in the pit?—Yes; 30 fathoms of the lower part of the brattice was blown out by the explosion.

2123. The pit was divided into three parts or shafts?—It was divided into three parts by a brattice from the surface down to the main coal seam.

2124. The whole of the injury done by the explosion in that pit was occasioned by the blowing out of 30 fathoms of the brattice above the main coal seam?—No; there was a partial ventilation through the wreck of the brattice, but it prevented access down the pits. The ventilation of those two pits did not mainly depend upon that brattice; it was not an up-cast and a down-cast shaft; they were two down-casts. Nearly an equal quantity of air passed down both shafts.

2125. What would have been the effect in that particular instance, if instead of the pit having a brattice, there had been two separate pits from the surface of the ground?—Then of course the accident of blowing out the brattice would not have happened.

2126. And those men's lives would have been saved, in all probability?—Yes, in all probability 40 to 50 lives might have been saved.

2127. What would have been the objection in a case of that kind, instead of using the bratticed pits, to have sunk two separate pits?—We prefer sinking two pits: whenever circumstances will permit, we are in the habit of sinking double shafts, because the repair of the bratticed pit is so great; I know it in some shafts to have amounted to about 1,500*l.* a year, including all the collateral expenses connected with it. The large furnace at the bottom is continually drying the timber, and we are obliged to pour water down the up-cast side to keep it cool and wet, to prevent its firing. We have had some horrible accidents from the shaft brattices catching fire.

2128. Do not you think, as a general system, that the system of bratticing pits is very objectionable?—Yes, it is in one sense, but it is indispensable in another, viz. from our deep pits having to be sunk through enormous feeders of water, and other causes. I have known pits sunk through feeders of water of 3,000 gallons a minute, which we are under the necessity of stopping back by tubbing or caissons. There are several feeders tubbed off in this very pit.

2129. That water is generally near the surface, is it not?—It varies; the lowest feeders we have at Wallsend are at about 70 fathoms from the surface.

2130. In case where you required a double current, or three different currents, what would be the probable expense of one bratticed pit, or of three small pits close together?—It would very considerably increase the expense in the first instance, to have three small pits.

2131. Having caused a considerable expense in the first instance, would it be attended with considerable saving afterwards?—In pits of moderate depth it would, but not in pits of great depths. In pits of from 50 to 100 fathoms we can generally manage them in any way, if free from quicksands; but when we come to pits of 150 to 200 fathoms, it becomes a different question.

2132. Would you require brattices to guide the corves if there were separate pits?—Not in all cases.

2133. But as a general system you would say, from your experience, with regard to the safety of the men working and the efficiency of the work, that it is desirable to have separate pits?—It is; I always practise it where I can: we have a great many done in that way: in all the late sunk collieries that I have had to do with, where it could be practised, it has been done.

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2134. And excepting the consideration of the water, do you consider that there is much extra expense in the sinking of two pits rather than one large pit?—It costs more money.

2135. How much?—It depends upon the size of the pit.

2136. You have spoken of the difficulties attendant upon sinking pits; will you give the Committee a case of the most difficult sinking which you have encountered in the course of your professional experience, as affording the Committee an idea of the difficulty of multiplying shafts in certain circumstances?—We have difficulties of various kinds; the chief difficulty we have to encounter is the sinking through quicksands, accompanied by large feeders of water; that is the first difficulty: the next difficulty of importance is the meeting with large feeders of water at considerable depths.

2137. As those shafts cannot be placed at any considerable distance apart, consistent with the economic arrangement of the mine, would not the same difficulties be encountered successively in each shaft?—They would; and I conceive, according to the plan suggested by the Committee, it would be utterly impracticable to sink two pits near together through a quicksand. I will give the reasons: Always in sinking through a quicksand, even with the best caisson, (or what we call a drop-tub), that we can put in, we find great difficulty in the sinking. I have put in drop-tubs of 12 or 15 feet diameter of cast-iron; in spite of all the security that we can give, it is difficult to keep those tubs in their right position. When accompanied with large feeders of water, the sand floats and is drawn up through the pumps; the consequence is that large excavations are formed and the surface of the ground is liable to sink. I have seen a crater a hundred yards in diameter formed in this manner; the whole surface within that circumference went down to the depth of several feet.

2138. What depth is the quicksand?—We have had them at the depth of 30 fathoms or more from the surface; they generally lie below the upper bed of clay, which is very hard, and then we meet with them down towards the rock called the stone-head. It will appear clear to the Committee, that when the whole surrounding mass is disturbed in this manner by the sinking of one pit, the attempt to sink another pit close to it would inevitably risk the further shrinking of the caisson that was already broken, and thereby in all probability ruin both pits.

2139. What would be the difficulty of making double caissons, supposing, instead of being one of 12 feet diameter, there were two together?—That is assuming they will go down, but the difficulty is to get them to sink in the sand. I have known 500 tons put upon a caisson to sink it, with the engine pumps fixed upon it also, to force it down. I have had also, in difficult cases, a number of men with heavy mauls standing round the circumference of the mine and striking all together, by word of command, as an impulse of that kind is much more efficacious in causing a tub to sink than a steady pressure. We have also tried the falling of rams, and likewise the swinging of heavy pendulums to get a kind of vibratory motion given to move a tub when stuck fast. The great difficulty is to get the tubs to sink, owing to the lateral pressure, as well as the resistance from the sand. We have often to strengthen the shell of a cast-iron tub by frames of timber or cribs placed in the inside, and my experience has led me to conclude that about 30 feet is the greatest depth we could succeed with safety in getting a large tub down. I therefore adopted the plan of one length or portion of a tube sliding within another, like the slides of a telescope. One of the principal difficulties we have to encounter in sinking through quicksands is, that they seldom form a regular stratum; they are subject to be interstratified with levy clay, and it frequently happens that one side is hard and the other soft. From this cause I have seen the soft side of a pit washed out to a considerable distance, while the other stood firm. The clay on the firm side of the shaft soon swells from the effects of the water and atmosphere, and forces the tub out of its true position. To guard against this as much as possible, the tub is suspended by tackles, generally about six in a large pit, or according to circumstances. I always make the bottom part of the tub conical, but no more, and before they go in, to reduce the friction as much as possible, they ought to be well smeared with soft soap; I conceive that the conical part makes way for the straight part of the tube above. Whilst the tub is sinking, the use of the tackles at the different quarters is not to lift the tub but to regulate its descent and to prevent it from going out of its true position as much as possible, as it always has a tendency towards the soft side of the pit. This tendency is also counteracted by laying weight on the top of the tub, at the hard or

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stiff side of the pit. Notwithstanding all these precautions, however, it seldom happens that a tub can be kept in its true position in sinking through a formidable quicksand. Having explained the difficulties which we are subject to in sinking of our pits, it will appear very clear to the Committee that they would be greatly increased if we had two pits to sink close together, or even within 50 yards of each other, as under such circumstances the one would injure if not destroy the other. If two were to be sunk so near each other, one would have to be completely finished before anything could be done with the other.

2140. Suppose the supporters were elliptical, and there were a permanent division across the centre of the loops?—I do not think that it would by any means sustain the pressure. The tubs generally do get a little elliptical from lateral pressure, in spite of every means in our power to keep the circle true. I have known a tub, when it got flat-sided or elliptical, go smash together at once.

2141. Supposing an elliptical cylinder that has a permanent division of iron in the centre, would there be any difficulty?—I do not know that there would be any difficulty, but that would require an enormous weight and strength of iron.

2142. Supposing the second pit were not begun till the first pit were fixed in the quicksand, would there be any difficulty in sinking the second?—Yes, I think there would be great risk in sinking the second, by disturbing the first.

2143. In addition to the difficulties which attend the planting of the caissons or cylinders, is not the expense of so much iron-work a formidable consideration?—It is not so much the expense of the iron-work, as the labour and risk; in the most critical quicksand, the greater part of the sand is driven through the pumps, and the wear and tear of leather and of the tackle, and the injury done to the engines, is enormous; thousands of tons of sand are sometimes drawn through the pumps.

2144. What is the greatest amount of engine-power which you have ever known necessarily brought into operation for the purpose of sinking a shaft through a quicksand?—I cannot say in engine-power precisely, for the engine was calculated for 120 fathoms, and the quicksand lay only at the depth of 30, but there were two 18-inch bores employed in it.

2145. Is it a common occurrence that a brattice pit is used for the winding in two parts of it?—Yes; the corves are drawn on each side.

2146. What is the advantage of that?—In the wear and tear we should save 80 per cent., I suppose, when they are separate pits, for the separate corves.

2147. Is it a common occurrence to have currents going up and down in the same shaft?—Yes.

2148. What is the advantage of having that extent for the current of air?—It is to enable us to get a sufficient quantity into the mine; it is a substitute for the two pits.

2149. Supposing these pits were 100 yards apart, would there not be the same facility of winding up those pits as up a single-brattice pit?—Yes; but after we have got one pit down with so much difficulty, we have no great appetite for putting down another.

2150. Can you give the Committee any idea of the expense of sinking a difficult shaft?—I cannot; but I believe there are some that have cost 40,000 *l.* and upwards to reach the coal. The cost varies according to circumstances, so that it is impossible to give an accurate account; I mean the cost including all the outfit of the engine and machinery, and everything of that kind.

2151. Supposing a pit to cost 30,000 *l.*, would it be a saving to have two pits, taking into consideration keeping the brattice in repair?—I would not say that; but when gentlemen have expended 50,000 *l.* or 60,000 *l.* in sinking one pit, it might not be convenient to expend 20,000 *l.* more in sinking another, merely to avoid the chance of any accident that might eventually happen. In fact, I conceive if there were any legislative interference on that point, it would tend to extinguish a very large proportion of our coal mines.

2152. You sink pits as sparingly as possible?—We do.

2153. Does not that in some degree tend to increase the danger of the mine?—It does in some degree; but if the Committee look to the plan of Wallsend colliery, they will see that there are more pits in it than in any other colliery in the north of England, for there are no less than five shafts for the ventilation of 100 acres, which is only equal to 20 acres for each pit. I believe it is a rare instance; I do not believe there is any other colliery that has such a number of pits for the like extent of workings.

 2154. There

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2154. There is a larger proportion of inflammable gas in that seam than in any other seam in the north of England, is there not?—There may be; but if all the pits in the kingdom were applied to that particular part where the pillars have been worked, we could not command the air so as to effectually expel the gas; it is the application of the ventilation that we want, underground, in those parts, and which we cannot effect after we have removed the pillars.

2155. Suppose you were to work that mine, so as to obtain 50 per cent., and leave the rest, might not that be advantageous as far as regards the ventilation?—It would certainly be a much safer mode of proceeding, but it would not pay.

2156. Do you conceive that 13 ½ per cent. or 15 ½ per cent. difference, is a compensation for the accidents that have lately occurred?—Yes, I think it is; for getting so small a proportion out of the mine, we must run very fast over, and soon exhaust it.

2157. Will not the late disaster have occasioned enormous loss to the proprietors of that mine?—Yes; but I can state that I do not believe that that mine was in any more dangerous state than perhaps all the mines immediately round about it, for there is not one of them that has not these old workings where the pillars have been taken away, and that are remaining unventilated, and it is possible that any one of them may be set on fire any day.

2158. You are alluding to the means of working in the Bensham seam?—No, in any other seam; as in this respect they are all nearly alike, only some more fiery than others.

2159. Is not the Bensham seam considered the most dirty seam you have?—It is, because it has been but partially worked as yet in the country.

2160. Do not you imagine that that seam will become more safe as it is more explored?—I have no doubt but it will become more pure, because all the pillars that are standing firm become exhausted of gas in this colliery; each coal pillar, taken individually, after a certain time exhausts itself of its gas. It is very singular that this seam is only so fiery just on the north side of the Tyne. I speak of my own knowledge of the adjoining colliery of Jarrow, in the same seam; in the north part of the Jarrow colliery, which adjoins Wallsend, it is as fiery nearly as Wallsend; but at a few hundred yards to the south of Jarrow pit there is comparatively little inflammable air; and again, at the Manor Wallsend colliery, I am told that there is a very trifling quantity of gas.

2161. Is there any fault or trouble between that part of the mine which is most fiery and the other side which is not fiery?—Yes; and I can speak more particularly to Jarrow: it is a fault, a slip-dyke, which makes a line of demarcation between the foul part of the mine and the comparatively clean part.

2162. Taking into account the contingencies arising from the possible neglect of lamps or fires in the mine and the neglect of doors, you consider you have been what is termed remarkably lucky in escaping for 10 years without any serious accident?—Yes.

2163. Do not you feel it to be an awful responsibility to have the charge of such a mine?—I do.

2164. Do you think you are compensated by any saving of the 13 per cent. for those constant apprehensions which you must entertain?—I do not think I am: I do not feel that I can consistently carry on the colliery on my own responsibility after this. If the colliery is to be carried on, I must have the sanction of competent judges as to the prudence of doing it; because I feel that although I may say that I can place this colliery in as safe a state as it has ever been in, I cannot say that it will continue so for any definite period of time, as a similar casualty might happen in a day or an hour after it was put right and placed in as safe a state as it was on the morning that the accident happened.

2165. In fact, after the exercise to the utmost extent of your professional skill, you cannot feel certain that at any moment any one of those contingencies may not create a repetition of the catastrophe which has lately happened?—I cannot; because it is dependent upon causes and circumstances over which I have not any control.

2166. Before you set that colliery to work again, you will hold a view upon it; that is, call in the assistance of able professional men besides yourself?—Yes; and upon their report I shall offer my own opinion, but I shall not act upon it. I must be guided by the report of persons whom I shall call in; I feel it too great a responsibility to take upon me individually.

2167. Your personal position is simply this, that being called upon by the proprietor

prietor of the mine, your best professional skill will be given to render the mine as safe as possible?—Yes; I know all the particulars of it as well as any person, and I shall give my best opinion and advice upon it.

2168. In speaking of the contingencies which attend the working of these dirty seams, allusion has been made by former witnesses to the propriety or impropriety of entrusting the main doors to the charge of very young boys; what is your opinion upon that subject?—With respect to the main doors, if there are three together, there is generally a man and two boys stationed: if there are two doors, there is generally an old man and a boy. The main doors, namely, those doors on which the ventilation of a whole division chiefly depends, are seldom, if ever, entrusted to a boy.

2169. But the care of the other doors may, under certain circumstances, be of equal consequence as regards a more limited portion of the mine?—Yes; we generally have boys at the board-end doors, which are placed to pass the air into individual places, as boards, headways or walls.

2170. Are not those doors liable to be injured by the lights blowing out, and the carriages running foul of them?—Yes; sometimes a horse may be driven through them, or a door may be broken or left open by the negligence of the boy; sometimes they are broken by a tram being run against them. But it is to be observed, that the injuring or neglecting of those doors does not derange the general ventilation at all.

2171. You state, in the Wallsend colliery you have always duplicate doors, and sometimes three?—Yes, the man doors.

2172. If one of those doors sustained the injury which has been hinted at, and the other were an imperfect door, would not the risk be very great?—No; it takes some little time before the current of air is affected: it does not change instantly, because the air frequently continues its course for a while by the impulse it has previously had; it does not at all times immediately feel the opening of those doors; it is almost impossible that those doors could be injured and not observed.

2173. But the distance between the foul drift and the pure air-course is frequently very short?—Yes; but the openings between are always built up sufficiently tight and secure.

2174. Is there not a short bye-way or passage for waste-men?—Only occasionally. I could point them out on this Wallsend plan. The nearest outlet for the waste-men from the point of danger in the east division is about 600 yards. That is the place (*pointing on the plan*) where the waste-men go on, from the commencement of the gas drift, and where it receives the gas from the pillar working: from which point there is no outlet for them for 600 yards; they must therefore travel the gas-pipe 600 yards before they can get out of it; and then they get out by a main door, which is kept locked.

2175. Do you recollect whether it was stated on the inquest held at Wallsend, that the two drifts were within 40 yards of each other?—Yes.

2176. That a communication was maintained between them?—Yes; but they frequently are much nearer; we think nothing of that; but the communication is through those man doors, as it is frequently necessary to go into those passages to see that they are all clear and open.

2177. You have stated that the locks or staples have been frequently forced away for mischief or theft?—Yes, they have been; and if I am not mistaken, twice within the last six months.

2178. And that the candles are used at no great distance on one side of the door, and the lamps used on the other side of the door?—No one goes into these drifts but the waste-men, whose especial duty it is to travel them to see that they are clear and open, and nobody else is allowed to go there; they always use lamps.

2179. Was not there some allusion to the lamp being too near these doors?—There was, by one of the workmen. I conceive that the case alluded to was of no importance. I know the place alluded to perfectly well; that lamp was burning in the *first* of the air, the *pure* air current, and out of all danger; and this poor man was in a state of great distress, having lost four sons, and was most anxious to find out some cause if he could; but though he made that observation that the lamp was near the main door, he admitted that there had been no fire in that part, and that the explosion could not have happened there. This man is the only survivor that was in the place at Heaton colliery when the water broke in; his name is John Bell.

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2180. In the working of your mines in the north, are you in the habit of leaving the small coal, what is termed in Staffordshire the slack, for any length of time?—Yes, sometimes we do.

2181. Does not that produce accident?—No; it is of a perfectly different nature from the Staffordshire coal; we have no *ground* fire.

2182. At the time this accident took place was there any accumulation of slack or rubbish?—Very little.

2183. Though this slack does not produce the fire which it does in some counties, is not there a quantity of gas evolved from it?—No, it becomes effete in a short time.

2184. Does not the gas become damp?—No; we are obliged to lead water in tubs to water the railways, or the people would be almost suffocated with dust.

2185. With regard to the accidents that may arise from falls, supposing a piece of coal or stone to fall from the roof upon one of those lamps and fracture the gauze, could anything prevent an explosion under those circumstances?—I have known the gauze crushed and go into a state of collapse, but I never, except in one instance, knew it fractured.

2186. Does not it at once call for minute examination of the quality of the lamps which you receive?—It does, and we are most particular in that point. I am ready to state the nature of our lamp discipline.

2187. Has not some charge been brought against the viewers on the Tyne and Wear for entrusting the care of the Davys to very young and careless boys?—I do not know; I am not aware of any such charge; but those boys, whenever they have occasion to travel, must have their Davys to travel with as well as the men, but we seldom allow them to have any light at the doors.

2188. So far as your experience goes, suitable men have the charge of the lamps?—Always; a man called the "Davy-keeper," whose especial duty it is to attend to them, is appointed for that purpose; and when the proper time arrives, I will describe the manner in which they are managed.

2189. Do you know whether, in ordinary cases of working near the goaf, the lamps would light when placed near the roof, when they would not lower down in the mine?—Yes, I have often done it; when I am down I examine the goafs to see their state, and I take the Davy in.

2190. Would you not suggest to the hewer, where you had any apprehension of the state of the mine, occasionally to elevate the lamp as a test?—We try it always; it will frequently not fire at the roof where the men are working, when it fires in the goaf behind them. At that part where the men are working they can only hold the Davy up to the roof.

2191. Do the workmen ever take upon themselves to remove the brattice into the board, in the absence of the deputies?—They do sometimes, when the air is too strong and annoys them, but then they are reprimanded or punished for it.

2192. That is another of the contingencies?—Yes; but it would only fire to a limited extent in that single board, because we examine what we call the *returns*. When I go down a pit, I can get in a few minutes into the return, that is, the current of air which has passed through all the workings. The moment I look at my candle I know the degree of inflammability, and I know whether it is dangerous or safe; if I find the return what is called thick, heavy, or very heavy, then of course there is danger. The next step is to go immediately into the workings among the men; and if we find nothing there, we are quite certain that the discharge of gas has taken place somewhere between where the men are working and where it was examined in the return; but I have never yet found our fresh air returns in this unfortunate mine in a dangerous state, that is to say, the ventilation in the candle districts or whole workings was always perfectly safe.

2193. Are you speaking of the return in the furnace?—No; there are many returns beside the furnace return; where it comes to the furnace it is called the *last* return, because it has then the whole accumulation of vitiated air from the mine mixed with it, to be discharged up the up-cast shaft.

2194. But you admitted that the brattices are either necessary or unnecessary?—They are all necessary, but the effect of withdrawing the brattice out of a single board would be the mere explosion of the gas in that particular place.

2195. Might not you have some secret communication with some foul part of the mine?—That could not well be, without it rendered the whole current of air explosive, and then it might fire; but when we see that the air passing through a whole division of working is not inflammable, we are quite sure that any partial explosion,

explosion, in any particular place, can extend only to that place; but if the air was *very heavy*, I should then expect a general explosion in the division through which that vitiated current passed.

2196. In opening the door you allude to, would it not render any other seam foul?—If that door was thrown open which this man alluded to, the immediate effect would be to render that particular part of the pit safer than it was before, because it would allow the first of the air to pass directly into the other chambers or workings to leeward of it, but it would at the same time lay the other part to windward *dead*. It would improve the ventilation of so much of the leeward workings for the moment in that particular place where the man was working at the time.

2197. That would be liable to happen in any seam, and is not peculiar to the Bensham?—No, it is not.

2198. In addition to the other contingencies, you have expressed a general opinion that those accidents may result from the sudden discharge of electricity produced from natural causes?—They may, but that is generally visible. I have never known an explosion from lightning, except when it ignited the gas at the top of a pit.

2199. Will you give the Committee any instance which you think will illustrate the circumstances of such an ignition, in any case in which the electric spark has lighted a mine?—Yes, the Lawson mine pit was exploded by the lightning.

2200. What was the depth of the colliery at Lawson mine?—It was upwards of 70 fathoms.

2201. Was it what you would call a fiery colliery?—Not particularly so, very slightly in the main coal seam; it was upwards of 130 fathoms deep to the lower seam; but the shaft had been filled up to the level of the upper seam for many years.

2202. Then this explosion took place at a depth of upwards of 70 fathoms from the surface of the earth?—No, it took place at or above the surface; the pit itself had become a gas-pipe; something had happened, which I do not immediately recollect, to derange the ventilation. I had nothing to do with the colliery at the time, but I happened to be near the pit during the thunder storm. The ventilation having been deranged, as already stated, the whole of the workings below were filled with gas, as well as the shaft, and consequently the shaft itself became a gas-pipe, and was then discharging what was generated below. This discharge was ascending in a current from the mouth of the pit when the thunder-storm came on; a flash of lightning ignited the gas, and a very heavy explosion immediately ensued.

2203. Was there a current of atmospheric air passing through the mine at that time?—No, there was no ventilation in the pit at that moment.

2204. Is it not known that carburetted hydrogen will not explode without a mixture of atmospheric air?—Yes.

2205. How could the carburetted hydrogen which was in the pit explode, unless there was a current of air?—Because in such a case it supplies itself with a sufficient quantity of air to make it explode. If you fill a bottle with this gas and set fire to it at the mouth of the bottle, as long as there is an outward pressure it keeps burning at the mouth, but by-and-by it creeps down into the bottle, supplying itself with as much air as keeps it burning for a while, and then explodes. I have known a pit shut up for three weeks as close as we could make it; the coal was on fire below, and we thought we had it sufficiently fastened up to prevent explosion, but at the end of three weeks it exploded, although the fire below could only have been supplied with fresh air through the fissures in the rubbish at the top of the pit.

2206. You state this to show that it is impossible to prove how much atmospheric air may be supplied under those circumstances?—Yes; but it supplies enough to produce explosion. I went to see the havoc that had been made at the Lawson main pit, and had been there a short time, with a great number of other people, when another explosion, a most furious one, took place, when I was within 18 feet of the top of the pit.

2207. How far had the explosion passed into the workings?—I should conceive but a short distance; indeed there was not much space below.

2208. The explosion was in the pit?—Yes, and in part of the workings. There might be an interval of an hour and a half between the two explosions.

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2209. Was the explosion so immediate upon the flash of lightning as to leave no doubt of the lightning being the cause?—I cannot state the interval between the flash and the gas being perceived to be ignited, but I understood it to be instantaneous.

2210. Have you ever thought of the possibility of the electric fluid descending through the earth, conducted by any metallic vein or otherwise, in such a body as to occasion subterranean explosion?—I have no reason to believe that it has occasioned subterranean explosion; but I know a fact, recorded by my father, of the engine-pump having acted as a conductor, and carried the electric fluid to the bottom of the pit, but I do not know it of my own knowledge.

2211. Does your information state that the approximation of the electric fluid to those pumps was perceptible to the by-standers?—My father saw it.

2212. And what were the consequences, as he described them?—Nothing injurious; the fluid ran down the pumps into the water at the bottom of the pit, and nothing excepting a considerable noise was occasioned. There was an engine-wright in the shaft at the time, and he was alarmed by the rattle it made, but he was not injured.

2213. Can you suppose a case of the sump or pump-well being dry, and the wind-bore of the pumps being surrounded with atmospheric air mixed with carburetted hydrogen; might not such a circumstance occur?—It might, possibly, but I am not aware that it ever did occur.

2214. What would your theory be, if the bottom of the shaft was in a foul state?—Explosion immediately, because in certain circumstances the gas may be fired by the electric spark.

2215. But you have never seen cause to suspect subterranean explosion from the cause alluded to?—No.

2216. You proposed to state to the Committee the discipline of the mine, whenever you were working dirty seams, as connected with the use of the safety-lamp?—Yes; I cannot do better than explain the discipline in this very pit in which the accident happened.

2217. Are the lamps in general use in the county of Northumberland made by the best lamp-maker in the town of Newcastle, Mr. Watson?—They are. I lately had reason to find fault with the manufacture of some lamps, and more especially with the gauze; that is not very lately, perhaps 12 months ago; for people were going round selling gauze cheap, which was not what it ought to be, and from that time I have found it useful to carry a piece of standard gauze in my pocket, one inch square, with a small lens, which enables me to examine the state of the gauze and cylinders accurately. When there is any doubt that the gauze is not the proper thing, my small lens (the same as is used by the Paisley manufacturers for examining their muslins) enables me at once to ascertain if the gauze is of the right sort. There is an aperture of a quarter of an inch square in the frame of the lens, which forms a proper gauge for the meshes of the gauze. This is a piece of the standard wire-gauze of the right size, and by placing this little instrument so, and looking through the lens, you may count the number of apertures in a quarter of an inch as a multiple for a whole inch; that is what I call my gauze gauge.

2218. To the correctness of the gauge of the wire you attach the greatest importance?—I do.

2219. Does that examination enable you to criticise the construction of the gauze?—Yes. The Committee will see by the lens that there is a kind of indentation that prevents the movement of the wires where they decussate when the workmen brushes the inside of the cylinder to clean it, so that he cannot displace the gauze by any ordinary application of the brush.

2220. Was there any other defect in the gauze?—The irregularity of the interstices is to be apprehended. By placing the lens upon the cylinder in any lamp I immediately perceive whether the gauze is regularly made, and if it is in good order. The number of apertures per square inch in that standard size is about 784; it may vary between that and 800.

2221. Have you ever met with any gauze so slightly constructed that the indentations you have spoken of were by no means perfect?—I have not examined any lately, for I have repudiated the whole of that sort of gauze; if it differs from the standard I do not allow it to be used, and I have prohibited the use of any such gauze. I have samples at every one of the shops where our Davy lamps are repaired, with the strictest injunctions that no other gauze is to be used but what corresponds with that sample.

2222. Is this gauze that you have made the one originally prescribed by Sir Humphrey Davy?—I think it is, as near as may be. I do not at this moment recollect the number of apertures which he prescribes; it depends upon the size of the wire; but in my very extensive practice I have found this to be perfectly safe.

2223. But you have reason to suspect that imperfectly woven gauze is in use in certain places?—I believe it is. I have not been in any part of the kingdom, with the exception of Whitehaven and Workington, in the collieries, where the Davy lamp seems to be considered a working implement; it is rather considered as a matter of curiosity or precaution to inspect certain places of the mine, to discover where gas may be found, rather than considering it as a working implement belonging to the mine. Now we consider it as an actual implement of our trade, as much as a pick or a maul; and hence it is that we have it under very strict regulation, and, I flatter myself, very good management. I may state that the number of Davys used in the collieries that I am immediately connected with varies from 1,000 to 1,500 in daily use; in the Marquis of Londonderry's collieries alone there are nearly 900 in daily use.

2224. Having that large number constantly under your notice, what should you describe as the accidents to which they were most liable in their use?—Nothing, I conceive, but violence or injury arising from some extraneous cause. In nearly twenty years' practice I have only known one accident happen to the Davy, and I am not aware of any other having happened. I have never had any distinct proof of any explosion which has taken place from the lamp. I know that it is affirmed the late explosion at the Springwell colliery took place from the Davy lamp; now I am utterly at a loss to conceive how that notion has prevailed. I was called in to a consultation, with other professional men, the day after the explosion there; and to the best of my recollection, all the evidence that we had about the cause of the accident was, not that it had happened from the lamps, but from the want of the lamp; the intelligence I received was, that one particular part of the pit was discovered to be in a dangerous state, the overman sent the boy for the Davys; the last man that got out met that boy going in with the Davys, but whether he had ever arrived at his point of destination is unknown.

2225. At what time did this accident take place?—It was in May, two years ago.

2226. Have you ever formed any experiment upon the Davy lamp, with a view of ascertaining what force is necessary to compel the passage of the flame through the gauze?—I have, not by myself, but in company with Sir Humphrey Davy; and I am very happy to have this opportunity of doing justice to the memory of my lamented friend Sir Humphrey Davy on this particular point. The lamentable accidents which, prior to the year 1815, had occurred in our neighbourhood naturally directed the attention of all humane persons to the subject. Sir Humphrey Davy was introduced to me by the late Bishop of Bristol, and he called upon me at the Wallsend colliery one day, to inquire into the nature and cause of this lamentable catastrophe; I explained to him as well as I was able the nature of our fiery mines, and that the great desideratum was a light that could be safely used in an explosive mixture. I had not the slightest idea myself of ever seeing such a thing accomplished. After a great deal of conversation with Sir Humphrey Davy, and he making himself perfectly acquainted with the nature of our mines, and what was wanted, just as we were parting he looked at me, and said, "I think I can do something for you." Thinking it was too much ever to be achieved, I gave him a look of incredulity; at the moment it was beyond my comprehension. However, smiling, he said, "Do not despair; I think I can do something for you in a very short time." I should think, to the best of my recollection, within 14 days he wrote to me to say that he flattered himself he had done the thing; that he had made a discovery which would answer my object, namely, the procuring of a safe light in an explosive mixture. In a few days he sent me down two of the Davy lamps, as nearly as possible like that before the Committee; but I have one of our working lamps with me. He told me that it would burn safely in an explosive mixture; that there was no hazard, except in exposing it to a strong current, by which the explosion would be passed through the gauze cylinder; he therefore cautioned me particularly against such an exposure; but he had a remedy for it. On the strength of his authority I took this lamp, without hesitation, into an explosive mixture. I first tried it in an explosive mixture on the surface, and then took it into a mine; and, to my astonishment and delight, it is impossible for me to express my feelings at the time when I first suspended the lamp in the mine, and saw it red

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hot; if it had been a monster destroyed, I could not have felt more exultation than I did. I said to those around me, "We have at last subdued this monster." Sir Humphrey some time afterwards came down to the north; he asked me if we had situations under ground where he could see the effect of his lamp. I told him I could show him in the pit every degree of inflammability in all stages, from the bare firing point up to the most inveterate mixture, the most highly explosive, that in fact would extinguish the lamp by explosion within the gauze cylinder. He went down this very pit with me in which the accident happened lately, the G pit at Wallsend colliery. I took him through all the various stages of explosive mixture; I showed him all the gradations, from the *thickening* of the air, which produces a little elongation of the flame, from a small admixture of inflammable air, to where we were working pillars, and where we were exposed to the discharge of large quantities of gas from the goaves. There we took the lamp, and suspended it for a length of time, till it was red hot, during which, at the same time, we exposed it to the ordinary impulse of the current of air, (there were currents of different degrees of inflammability); and in different parts we tried the lamp in a red-hot state, for a considerable length of time. I was present, and the underviewer, the overmen, and others were also present.

2227. Can you define the time in hours and minutes?—No, I cannot, but I should suppose from a quarter of an hour to half an hour, during which Sir Humphrey was explaining to us the nature of the lamp; it was a lecture, in fact, upon the spot, and how the time might pass during that interval I cannot tell, but I think we might be down the mine for a period of two or three hours altogether. He then explained to us the danger of exposing the lamp to a strong current of gas, or even to a strong current of explosive mixture, endangered, as it would risk the passing of the flame through the gauze, but he pointed out a remedy at the same time for that contingency, and which we have always used; namely, by a tin screen, which slides upon the frame wires of the lamp, and encircles the circumference of the gauze cylinder to an extent of about one-half to two-thirds of its circumference. He could not there show us the effect of the passing of the explosion, to make us sensible of the danger to which we were exposed in that way, and teach us how to avoid it. But some time previously to that, I accompanied him to one of the Earl of Durham's collieries, to what is called the Morton West pit, where a very large blower from the shaft, not from the coal, but from a fissure in the stone, had been for many years discharging up the shaft, by a cast-iron pipe to the surface, in a similar manner to that which I have already described at Wallsend. We took a length of hose from an extinguishing engine, with the jet-pipe upon it, and attached that to the blower pipe at the top of the pit; it was held horizontally, and the jet was thrown very forcibly out of the nozzle of the pipe; the blower was sufficiently strong to propel the stream of gas across the engine-house. I well recollect the pipe was held at the entrance of the engine-house, and the jet passed the explosion nearly to the far end of the room, for it was very powerful; the distance that the blower fired it was from nine to twelve feet, I should think. I held the lamp in the direction of the jet, and not having seen it before, I was not very apprehensive of its firing. It did not fire at first, but as I approached the end of the nozzle pipe, the gauze became heated red-hot and passed the explosion. The flame was as long, or longer than the breadth of the engine-room; I remember that it burnt the nap off my great coat and spoiled it. This experiment was repeated over and over again. Lord Durham himself was present, and a great many other persons, professional men and others, were present on this occasion. The force of Sir Humphrey's remarks at the time was, "Now, gentlemen, you see the nature of the danger to which you are exposed in using the lamp, and I caution you to guard against it, in the manner I have shown you. This is to show the only case in which the lamp will explode, and I caution and warn you not to use it in any such case when you can avoid it, without using the shield." In fact, this is a kind of test to which the lamp never need be exposed in practice; we never have occasion to approach the mouth of a blower so close as to expose ourselves to the blast of the issuing gas. Blowers are very different from pipes, as instead of issuing out of a single orifice, as from the jet of the extinguishing engine, they generally issue from a long crack or *thread* of indefinite extent; sometimes the thread may be a foot or a yard long, and occasionally I have seen them five yards and more long; when fired they generally form a sheet of fire, rather than a jet like a gas-pipe. In fact, I do not think I ever saw the orifice of a blower of any magnitude that was so small that I could not put my finger or even my fist into it; some parts of the

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crack or blower threads are close for a foot or two, and then open, and close again; and if you set all the orifices of one blower thread on fire, you may have it burning out in different places at the same time, but none exactly approaching to what you would call the end or nozzle of a pipe. The orifices are not circular, and consequently the jets from them are diffused and do not form a concentrated blast. It cannot be necessary in any case to expose the Davy lamp to the direct jet of gas from a blower. The only case in which I conceive danger can arise by exposing the Davy to the impulse of an explosive current is in travelling the gas-pipe drifts. Explosive mixtures occasionally occur there, when the current is moving with a velocity of from three to four feet per second, which is a palpable breeze, and sensibly biases the flame within the wire-gauze cylinder; in fact, it propels the flame against one side of the cylinder.

2228. Is the Committee to understand that that is when the lamp is carried or when it is stationary in foul draught?—Either in the one case or the other.

2229. You make no difference when the lamp is carried against the stream?—Yes, that causes a double impulse, if the person carrying the Davy is going with the same velocity to windward as the air is moving; but we use the lamp in this manner as little as we can; our rule is, to travel with the current of air as much as possible. All the people employed in this occupation, the waste-men, have shields upon their lamps, to shelter and prevent their being affected by the current; and moreover, they carry their lamps in a particular manner when they are travelling either with or against the current, by which they shelter them by their bodies, and the shield is always opposed to the direction of the current.

2230. Why is not the shield made of a transparent substance?—We do not find it necessary; the tin shield in some degree answers the purpose of a reflector, and the cheapness of the tin is also an object.

2231. If it was a transparent substance it would give light upon that side as well, when the blast came?—Yes; but anything in the shape of a lantern or lamp is much better not to give light on both sides, and it shows a more agreeable light with an opaque shield, especially when you are travelling in numbers together. The naked Davys do not afford so agreeable a light in travelling as those with shields, in my opinion.

2232. The tin shields do not dazzle the eye so much?—They do not.

2233. Though the danger is imminent in travelling those wastes, the men are so accustomed to it, and understand the theory as well as the practice of using the Davys so well, that you never knew an accident occur to them?—I never did. I can only say, that from the time of the invention of this lamp, and getting them introduced as quickly and as extensively as possible, I am quite certain that I have not for many years had less than 1,000 lamps a day using, and frequently 1,500, and I can state that I never have known an explosion happen from the Davy lamp; not even one solitary instance. I have seen them in operation, and been with them myself in all possible varieties of explosive mixtures to which they can be exposed in our mines. From my experience, I have perfect confidence in them; and when I state, during the number of years (nearly twenty) which I have had those lamps in daily use, that I do not know of one single accident having happened from them, at least as far as my own experience goes, I think I am warranted in pronouncing the Davy lamp to approximate as nearly to perfection as any instrument of human invention can do. This is my decided opinion.

2234. When they are travelling those wastes with the Davy lamp, the gas is constantly exploding in the lamp?—Not always; there are a thousand degrees of explosive mixture. In some cases the gauze cylinder is not quite filled with flame; a column of flame, about the thickness of your finger, goes up to the top of the cylinder, but does not fill it full. The heat collects at the top by the apex of the flame impinging on the gauze cap, and it then heats gradually downwards.

2235. Have you examined any of the other lamps upon the table?—I have not. Mr. Upton was so good as to explain to me his improved lamp this morning.

2236. What is your opinion of that lamp?—I think it a most excellent lamp, and in many cases it might be useful; but I must own I do not see any difference in principle from the lamp of Sir Humphrey Davy. I think, if I understand it rightly, it is neither more nor less than Sir Humphrey Davy's wire sieves. As an individual so deeply interested in the question of safety-lamps, both my life and property being staked upon them, I must express my gratitude to all those gentlemen who have so laudably interested themselves in attempting to improve them. I feel particularly obliged to all those persons who have done so. Dr. Clanny is a continual and indefatigable labourer in the vineyard, and I believe that he has

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the merit of having first directed public attention to the subject of safety-lamps. I am sure we have all but one object in view, and that is to arrive at the best possible lamp that we can. I am not sufficiently conversant with Mr. Upton's invention to know the precise difference in principle; but I have in my hand Sir Humphrey Davy's pamphlet, and I think the Committee will perceive that his first idea was to feed the flame through a series of tubes; whether they were circular or in any other shape, they formed the principle which led to the invention of the wire-gauze *sieve*, and ultimately to the wire-gauze cylinder. I beg to refer to Fig. 10. in his pamphlet, in which he has a wire-gauze sieve at the bottom and a wire sieve at the top. I do not, as I said before, discover any difference of principle between this and Mr. Upton's lamp; but there are many precautions taken in Mr. Upton's lamp which add to its safety; there is more strength in it; he combines the principle of the gauze, as it were, for a dernier resort, in case of the glass being broken; and he certainly feeds the flame immediately from below, and by that means prevents the explosion of the gas higher up the cylinder.

2237. Does not his plan arrive at this point, that it prevents the flame of the lamp ever approaching the gauze itself?—Yes; I believe that is Mr. Upton's object, that is, to feed the flame without igniting the gauze in the gauze cylinder. As a greater security, Sir Humphrey Davy presented us with a double-gauze cylinder and a twill-gauze cylinder, to render the lamp more safe. I have a twill-gauze lamp with me now. These we have not found useful; they did not give sufficient light, and we soon got such confidence in the single gauze that we exploded the others. I do not know that double or twilled gauze were used for more than six months after the invention of the Davy lamp.

[*The Witness produced a twilled-gauze lamp.*]

2238. Do you find a disinclination among the men to work with the Davy lamp?—Not the slightest.

2239. Do you think that the Davy lamps give sufficient light?—In clean seams, or seams not interstratified with foreign matter, the men are willing to work with them without any extra remuneration, and take them as freely as candles.

2240. Suppose the mine should require the introduction of the Davy lamp, is it usual to make the men any allowance for using the lamp?—Not in *clean* seams, but in a foul seam, interspersed with stone, split coarse coal, iron pyrites or other foreign matter, which requires the collier to select the coals, they receive a greater remuneration for using lamps, on account of the greater trouble and the deficiency of light; for I must observe, that at the time Sir Humphrey Davy accompanied me down the pit, we tried the comparative intensity of the light between the lamp and the ordinary pit candle, and found that the Davy lamp gave about one-fifth less light than the common pit candle. Then when the people are working in a foul seam we give them additional wages, called *consideration*, according to the extra labour and trouble it may require to clean the coals, but in a perfectly clean seam no consideration is allowed for using the Davys.

2241. Remuneration is sometimes given with a candle, in a foul seam?—Yes, but not so much as in the case of the lamp.

2242. Is it left to the men themselves to make use of the Davy if they please?—No, always by order; and I will now state the nature of our lamp discipline. I produce a lamp taken out of the hand of the overman who was killed by the late explosion.

[*The Witness produced the same.*]

2243. How long ago was this?—His body was not found till last Sunday week, in the morning. It is locked, but I have brought the key with me.

2244. What is that upon the meshes?—It is the smoke of the lamp.

2245. Would not that affect the lamp?—Yes, it might require cleaning, but I brought it in the state in which he had been using it; and if it got dull, he would give it to the runner to carry to the Davy man to give him a fresh one.

2246. Is that lamp in the state in which it should be used in the mine?—Yes, it is in what I call a good working state.

2247. It is not injured?—No. This man had relieved the other overman at nine o'clock, and went to the eastern division, and he might have changed his Davy two or three times for anything I know during that time.

2248. If the Davy lamp is extinguished, how do they light it again?—There are two boys called the Davy boys, each of them with about three lamps in their hands; they just take those lamps in their fingers, and they walk about amongst the work-

men; and if by any accident a man loses his light, one of those boys takes the Davy which is extinguished and gives him a lighted one; and when the boy has got rid of his stock he goes to a person called the "Davy man," who is a careful steady person, and who has a kind of office or closet, in which are pigeon-holes arranged to place the bottoms of the lamps in. This Davy man has only charge of the bottom part of the lamps, but he always has a stock of spare lamps ready at hand to supply those Davy boys, who go constantly between his cabin and the working.

2249. This cabin being stationed in a safe part of the mine?—Yes, always. This man, as the colliers finish their shift or day's work, receives the lamps from them; he unlocks and takes the bottom off each lamp, and the collier himself takes charge of the gauze part; he carries it home with him, and his business is to clean it, for which purpose he is provided with brushes that go into the inside of the cylinder; and some of them are extremely careful of their lamps, and have very great ambition in keeping their Davys in good order, in which case the gauze cylinders last a long time in such careful hands; however, others are slovens and do not keep them in good order, but generally they are kept in good order. In the mean time, the Davy man oils and fresh wicks and trims the lamps, and puts them all in good order. Next morning, when the colliers return to their work, every man comes (many of them have canvass bags or tin cases to carry the gauze cylinder in) and presents his gauze to the Davy man. It is then the duty of the Davy man to examine the gauze cylinder with all his care. If he is satisfied that all is safe and nothing amiss, he then lights; he screws the top on and locks it, and gives the lamp ready lighted to the collier, who goes off in succession, each as he gets his lamp; but if the Davy man discovers the slightest defect, (and from their practice it is quite surprising how keenly and quickly they can discover any defect), if he discovers that the inner top of the gauze cylinder is at all damaged by the flame, he condemns and rejects it.

2250. Is he furnished with magnifying glasses?—No, but they are quick-sighted enough, being mostly young men, to discover any defect immediately. After having furnished all the men and boys that have to go in with their Davys in proper succession and order, and locked them, he remains at this station for so many hours till he is relieved by another man; and he remains in his cabin, his sole duty being to keep a certain number of spare Davys in order to supply the boys as they travel between him and the workmen, bring out those lamps that require relighting, and take in clean ones. That is the system that is pursued with the Davys, and the utmost vigilance is observed. If men go against orders through the Davy doors, as I have known an instance in one colliery, viz. Sheriff Hill colliery, an obstinate fellow passed through the Davy doors, in spite of the boy, who clung to him and seized his coat laps, and shouted murder with all his might; this man persisted in going on, but the little fellow stuck to him, and continued to call out murder, till the deputy overman was alarmed and came to him. This man was brought before the magistrate and was punished. At other times acts of inadvertence have occurred.

2251. Do the men ever take liberties with the lamps; do they open them?—No, not of late, I think; they have come to a better understanding on the subject. I have one colliery in which they work entirely with the lamps, and in very considerable danger; it is on a limited scale, but the whole charge of the lamps is left to the men themselves, and I believe there is not a better regulated set of lamps anywhere than in that colliery; the men however, generally, are becoming much better informed on the subject, and becoming more systematically careful.

2252. Do they ever take pipes into the mines?—Yes; we allow them to smoke in the candle-ways, but not where the Davys are used. I have known the pitmen light their pipes through the gauze; they can do that; but as tobacco does not burn with a flame, there is not much danger, unless there should be any extraneous combustible substance mixed with it that might flame from being ignited by the tobacco.

2253. The office of Davy man is one of great trust and importance?—Yes; but I am very glad to say, that now we are supported by the colliers themselves in enforcing attention to the lamps. For several years, when any man was brought forward for mismanagement or negligence with the Davy, the colliers would join in petitions in his favour; now the opposite feeling has taken place. I had a case about four years ago: A man, in a very dangerous situation, having taken off the top of his lamp, I had him taken before the magistrates, who sentenced him to three months' imprisonment. The colliers belonging the concern entirely approved of this sentence.

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2254. Do you observe any indisposition on the part of the colliers to use the Davy lamps?—No, not where it is necessary.

2255. Is there a readiness in the magistrates to punish?—There is; but the men have now taken up the subject themselves. On one occasion, where a man had taken off the top of his Davy in a dangerous place, I had him taken before the magistrates, who committed him to the house of correction for three months. The friends and relations of this man came to me to say that it was an exceedingly hard case; he had done it quite inadvertently; that he was a man of excellent character, and they wished me to intercede with the magistrates to mitigate his punishment. I said "It is all very true, but it is not quite so much my affair as it is that of the men; I do not wish to inflict punishment unnecessarily upon any man, but I think the colliers themselves are so much interested in this matter, that they should be the judges. If you will therefore get the men to petition the magistrates, I will join in it, as it is as much, or more, their affair than mine." The case was submitted to the men; they held a meeting, and I had deputation from them to state that they had maturely considered the case, and they thought that it was one which deserved the most severe punishment, as all their lives had been exposed to imminent danger by this man's heedlessness, and they therefore decided that he ought to undergo the full term of his punishment. I could not help lauding them for their decision, as I thought it was proper; and in that colliery I have never since had the slightest complaint of a want of care in the management of the Davys. This showed a spirit of correct feeling amongst the men, and was highly creditable to them. This was in the Benwell colliery.

2256. Does the Davy man receive considerable wages?—The ordinary wages of the Davy men are about 18*s.* a week, with house and firing.

2257. You are aware that one object of this inquiry is the extent to which accidents have occurred in mines; have you ever seen a work printed by a gentleman of the name of Sykes, of Newcastle, intitled "Local Records"?—I have.

2258. Have you seen his statement upon this subject?—I have.

2259. He appeals to you for the correctness of that?—He does; I have furnished him with many of the accounts.

2260. Do you see any objection to that being taken as a whole upon the Appendix of this Committee?—I do not; I am afraid it is but too true a record of the melancholy facts.

2261. Is that correct?—I believe it is; but I have a manuscript copy with me.

2262. Will you have the goodness to compare that between now and the next meeting of the Committee?—I will.

2263. Have you any remark to make upon the nature or particulars of the evidence taken upon the recent inquest at Wallsend?—No, I do not think I have. I have explained with regard to the man who objected to the situation of the common lamp; but if, on placing the evidence taken before the coroner before the Committee, any question should arise upon it, I shall be very glad to give any further information I can on the subject.

2264. But your present impression is that that investigation was conducted with the greatest propriety and fairness?—This is my impression. I sent round to invite all the men belonging to the colliery; I gave notice that I wished not only the survivors at Wallsend colliery to attend, but also the colliers from the neighbouring collieries. Whoever chose to come might do so, to hear my statement as to the mode of ventilating the colliery, and hear the evidence taken before the coroner. It was an open court.

2265. The Committee do not see in the copy of the minutes laid on the table an account of the professions or trades of the jury impannelled; can you supply the deficit?—Many of them I can.

2266. Anthony Eastaby?—He is a merchant in Newcastle, and a great soap-boiler.

2267. The Rev. John Armstrong?—He is the perpetual curate of the parish.

2268. Mr. John Wright?—Mr. John Wright is a large ship-owner and landed proprietor in Wallsend.

2269. Mr. Washington Potts?—He is an extensive rope manufacturer in the neighbourhood.

2270. Mr. John Falm?—He is a farmer.

2271. Mr. Patrick Rye?—He is a farmer.

2272. Mr. William Jameson?—A cord maker.

2273. Is he employed at Wallsend colliery?—His father is, but he is a general corder, and is the corder of different collieries; he works by contract.

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2274. Mr. Robert Henry Coward?—I take that to be a mistake; I think the name is Coword; he is a staithman; but I am uncertain that I am right in this explanation.

2275. Mr. Matthew Elliot?—He is a grocer at Howden Pans, I believe.

2276. Is that near Wallsend?—It is about a mile and a half from it.

2277. Mr. Joseph Mordere?—He is the parish-clerk of Wallsend.

2278. Mr. John Rough?—I do not know.

2279. Mr. George Shanks?—He is a farmer at Wallsend.

2280. Mr. Charles Weatherley?—Staithman to Lord Ravensworth, Lord Wharncliffe, and Mr. Bowles.

2281. Have not there been attempts made to cast doubts upon the impartiality of the coroner on former occasions in summoning juries in like cases?—I know of none to which I attach any importance. The coroner sends his warrant to the constable, and orders him to summon competent persons; so that the coroner knows nothing about who is summoned until they appear before him.

2282. With regard to the jury in question, from your personal knowledge, could you have supposed a fairer jury summoned under the circumstances of that neighbourhood?—I could not indeed.

2283. From the period when Sir Humphrey Davy first produced his lamp to the time of his death, had you any further communications with him?—Very frequently; not only communications by letters, but I also visited Sir Humphrey Davy when I came to town, and he used to call upon me when he came to the north.

2284. Did he ever express the hope that he should make improvements upon that lamp?—No; in fact I was so perfectly satisfied with what he had done, that I did not ask for anything more; from its simplicity and portability it amounted to everything I could desire. The travellers, for instance, the waste-men, whose business it is to work and travel in the wastes for six hours daily, with small intervals of rest, sitting down occasionally at their halting-places, they are frequently travelling through places not above three feet or four feet high (and sometimes creeping), in a very uneasy attitude. None can do this sort of work but men in the constant habit of it, and they are obliged to sit down now and then to rest. Carrying this lamp for six hours in so constrained an attitude, renders it important that the lamp should be as light and portable as possible; and I question the ability of the strongest man to carry a lamp of that size for six hours, [*pointing to a lamp of greater size on the table of the Committee*].

Veneris, 3° die Julii, 1835.

JOSEPH PEASE, ESQUIRE, IN THE CHAIR.

Mr. *John Buddle*, called in; and further Examined.

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2285. THE Committee is desirous of asking you some questions upon the nature of the seams of coal on the western coast of Cumberland, as connected with the objects of this inquiry; will you have the goodness to state the depths of those mines, the height of the seams, and the general description of them as regards their being infested with foul air?—It is some years since I was in any of those mines, but the seams, generally speaking, are thicker than ours; the principal seam is about nine feet thick, I believe; I have not the exact section in my recollection at present, but I think I am pretty near when I state that it is nine feet thick.

2286. What do you consider to be the average of your seams?—We have seldom any above six feet.

2287. That is the least thickness that you consider workable?—We sometimes work as low as 20 inches.

2288. What is the depth of the shafts in those mines?—I do not immediately recollect, but there are some very deep shafts.

2289. From 100 to 200 fathoms?—I do not know that there are any of 200 fathoms, but I know that there are several of 100 fathoms and upwards.

2290. Do you recollect making any observation upon the ventilation of those mines?—I did some years ago. I have more than once inspected those mines; and

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I certainly must say, in speaking of the Whitehaven colliery as a mine, I consider it to be the finest in England, both in point of thickness of the seams and in extent.

2291. Are you aware whether any accidents of a fatal nature have ever occurred in that mine?—Yes; I know that fatal accidents have occurred in it.

2292. You have spoken of it by the term, "a fine mine." Do you intend to convey to the Committee by that remark that it is a mine that can be and is well ventilated?—Yes it is, but that was not my meaning in my answer. I meant that it was in point of extent and thickness of veins the finest mine; and I would further add, in point of ventilation, both as to the system adopted and in all its details, it is one of the most completely managed mines that I know of.

2293. Are you at all aware of the circumstances under which the accidents alluded to happened?—I know them only from hearsay. I do not know the precise nature of them, but believe them to be similar to those that we have had from causes that could not be controlled, in the working of pillars.

2294. Are those mines worked upon the same principle as the mines under your direction in the north?—They are; Lord Lonsdale's manager, who is a most intelligent man and an excellent pitman, adopted my system of pannel working, and working in divisions, many years ago, and has carried it to its fullest extent; and has also adopted what I call the "dam-doors," which are described in my pamphlet, written in 1813; by the operation of which, I understand that the coal which was set on fire by the last explosion they had in one division of the colliery, was extinguished; that particular division or pannel was entirely shut off from the rest of the mine by shutting the dam-doors, which excluded the atmospheric air, and extinguished the fire.

2295. What was the date of your last visit to the Whitehaven colliery?—I do not recollect, it is several years ago; but Mr. Peile, the viewer and manager of the colliery, and also his son, a very promising young man, who was a pupil of mine, wrote me the particulars, and informed me of the beneficial result of using my plan of the dam-door.

2296. Will you describe the dam-door?—The entrance into any particular district of the mine is by one or two openings; these dam-doors are fixed in strong and solid frames of timber, and the doors are made of three or four-inch planks, firmly bolted and put together as strongly as possible. They are suspended by hinges from the top, and made to fit perfectly tight; there is a stanchion set to prop them up; and they are never used at all but in a case of this kind, but they are shut in a moment by knocking out the prop which keeps them up, when they fall down like a port-lid, and shut tight against very strong stanchions made of fir balks. On first going into the division after the explosion, Mr. Peile discovered that it had set fire to the coal; there was no water to be had, and the fire could not be approached without incurring the greatest danger; consequently, the only mode by which it could be safely extinguished was to shut it off from all communication with the external air, which he immediately effected by letting the dam-doors fall and securing them effectually, by which means in a very short period that part of the mine was totally cut off from all communication with the other parts, and no air could have access to it to support the combustion of the coal. After allowing matters to remain for some time in this state, I do not recollect how many weeks, on opening these dam-doors again, and restoring the ventilation so as to render that division accessible again, the fire was found to be entirely extinguished. The operation had had the desired effect.

2297. Do you recollect whether any men or women lost their lives upon that occasion?—I believe a good many.

2298. Both men and women?—I believe there were some women, but I do not know exactly.

2299. Was the explosion, from the description given to you by Mr. Peile, an extensive explosion, considering the section of the mine?—Yes, I believe it was; but it was not what we call an explosion, I believe, but a heavy fire; that is to say, it did not make its exit at the top of the pit, consequently it was not a blast.

2300. In that case the after-blast did not drive away the props, which the Committee understand to be one of the great advantages you anticipate from the use of those dam-doors?—No, it is not the intention that the blast should blow away the props of the dam-door; the intention of the explosion blowing away the props is, in the case of what I call a swing door.

2301. What is the distinction between the two?—The meaning of a dam-door is to cut off all communication whatever with any particular division of the mine; but

but the swing door is for the purpose of preserving the air course in its proper channel, in the event of the main doors being blown away by an explosion. A swing door is suspended in the same manner as a dam-door, but it is a very light door, and swings on hinges between its stanchions, like a sign-board; it vibrates like a pendulum, where two main doors are fixed. The swing door is placed between them in a recess in the roof, so that if the explosion blows out the doors which are placed in this passage for keeping the current of air in its right channel, this swing door, being sheltered in a recess of the roof, escapes the force of the explosion. It is made to fit the aperture into which it has to fall, but it is constructed so as to vibrate like a pendulum. There is a slight prop set on one side of it, with the flat side exposed to the direction of the current, so that the very same explosion that will blow out the main doors that keep the air in its proper current when all is right, will also blow out the strut from under the swing door which is secured by the recess in the roof, and the door immediately falls down and swings till it finds its resting place, and thereby preserves the current of air in its proper channel without any aid whatever; it is a self-acting apparatus. My reason for having it exceedingly light is, that by the force of gravity it would find its resting place after a little vibration, while it would not be any obstruction to the people, even the smallest boy, that were wounded and maimed, because they can creep through under it, or move it without the least difficulty. I was led to the construction of that description of door from frequently observing after explosions, that when the very strongest doors and masonry were actually blown out and shattered to pieces, some of the feeble sheth doors were very little injured, they were blown open; so that they may be compared to the willow which yields to the blast, while the oak is broken.

2302. Has subsequent experience, since the adoption of that expedient, satisfied you of its value?—I have not had occasion to experience it, except in some few instances. I have no reason however to doubt the efficacy of the plan, whenever it may be brought into operation; and I have equal confidence in the effectual operation of the dam-doors.

2303. But the Committee wish to know whether you, as a professional man of great experience, would recommend all miners to adopt the swing door in case of liability to explosion?—I think I would; it is one of those kind of things which if it does no good it can do no harm, and it costs little; whenever main doors, in fiery collieries, are liable to be blown away by the force of the explosion, I think the swing door is a most admirable succedaneum for doors, because they will place themselves right when they are inaccessible to any person.

2304. If the main brattice remains whole in case of an explosion, and the air coursing is little injured, the swing door may save the lives of many individuals not absolutely destroyed by the first blast?—It might; it gives all the chance, so far as the main doors which may be destroyed, are concerned.

2305. Is it so light as to admit the first blast to pass?—It is sufficiently heavy to resist the ordinary current of air, but not so heavy as to resist the force of the smallest trapper boy from creeping through it.

2306. Then the door is propped up till the explosion happens?—Yes; I calculate from the manner in which the door is placed, that either the explosion, or the wind from the explosion, will bring it down; in short, a very slight concussion will bring it down. They would have been inoperative in this case of Wallsend, because the shaft brattice being knocked out, there was no current of air left in the pit to be conducted, the whole workings was left in a stagnant state by the blast.

2307. That accident in the pit at Wallsend shows, that the principal defect in the ventilation was in the pit, and not in the workings?—Yes; the great cause of the accident being so very extensively fatal, was the blowing out of the brattice.

2308. To return to the Whitehaven mine, at the time you visited it were the safety lamps in use in that mine?—They were.

2309. Universally?—Wherever it was necessary, in the manner I have described in which we use them with us.

2310. Do you recollect the particulars of the heavy fire or explosion to which you have alluded?—No, I do not; I was not there; I had an account of it from Mr. Peile, but I think his principal object was to inform me of the efficacy of the dam-doors.

2311. Would you compare it as a dirty seam with the Bensham seam?—No; but it is naturally more difficult of ventilation, because it is higher: it is as high

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as the roof of this room, and the current of air when applied there, cannot be so efficacious as in a seam half that thickness; the column of air moves in the inverse ratio of the area that it has to pass through, that is to say, the larger the area the slower the movement of the current.

2312. Does not air coursing bear a relative proportion to the size of the pit that introduces the air into the mine?—Of course the quantity of air introduced by the power of rarefaction, or the other means which I have described, may be considered as a constant quantity, because we keep the furnaces at the same pitch, as nearly as we can.

2313. Suppose the area of the pit and the area of the seam were a multiple of any given column which you have described as being very inefficient, would it not have the same effect if the areas of the pit were increased?—They would be so much the slower in the proportion, if that area were increased.

2314. Supposing the column were made one half the size, and the down current one half the size, would the velocity be increased?—No; to obtain the same quantity we must give double the velocity. The standard air course is generally 36 feet square, with a velocity of three feet per second; but if in any particular part of the mine the area is diminished one half, of course I must pass the current with double the speed to obtain the same quantity.

2315. Taking all the circumstances of the Whitehaven colliery into account, it is not what you would call a dangerous mine?—No, certainly not; it is only so far dangerous as it is subject to those casualties which, by our best mode of ventilation, we cannot counteract.

2316. Your impression was that every suggestion of art or humanity was in use in that colliery?—I am quite sure of it; it was so when I was at the colliery, and I have no reason to suppose that the discipline is at all relaxed since. Indeed, as a proof of it, I think that the very circumstance of the dam-door being fixed, proved that everything was attended to, and that the manager applied all the resources of his art to the very letter.

2317. Are those seams wrought to a considerable extent in the mine?—Yes.

2318. Are you aware of any observations having been made as to the effusion of gas in that section of the mine which is under the sea, as compared with that which is differently situated?—No; but I believe the deeper we go, the greater the evolvement of gas. As an illustration, I will take the Bensham seam at Wallsend, which is the most fiery that I have seen. I know that seam in several parts where it crops out to the surface.

2319. What is its thickness?—Five feet and a half thickness; its greatest thickness, including the band of stone, is six feet. I know the seam very well where it crops out to the surface, and where it has been worked to a considerable depth. In the first case there is no gas at all; but at a greater depth in the earth, although not broken by any slip dyke, it becomes gaseous.

2320. What is the rate of dip of that mine?—It varies exceedingly; it varies from an angle of six degrees to perhaps 15, in different places.

2321. What is the greatest depth to which they work?—I believe the greatest depth at which it has been discovered, is 264 fathoms; it is worked at that colliery now. The observations of natural philosophers, and so far as I have taken the temperature and the dips of our pits, the temperature appears to increase about one degree of Fahrenheit for every 20 yards in depth; hence some scientific people argue as to the existence of a centrical fire.

2322. What do you put the first 20 yards at?—That has reference to the atmosphere. If you find the temperature of the air at 30, then, of course, at 20 yards down it ought to be 31.

2323. In such a day as this, when it is 70 on the surface?—Still the heat is relative.

2324. Had the answer you gave relative to the increased evolvement of gas, the deeper the stratum, any reference to the peculiar situation of the seam at Whitehaven under the bed of the sea?—It has; and that is what I am coming to. I shall very briefly explain that: where a seam is continuous without any dislocation or slip-dyke, it is less gaseous towards the crop, because I conceive that all the gas that can be expelled at the natural temperature of the atmosphere has escaped; and as it gets deeper and deeper, its escape into the atmosphere is not so easy. Now the geological structure of the Whitehaven colliery, and more particularly, I believe, under the sea, is rather peculiar; and I consider it to be rather a fortunate provision of nature, for the safe and effectual working of those collieries.

collieries. The angle of dip in the Whitehaven collieries is considerably more than in our collieries; it is about one in six, I believe. The continual tendency of the seam or seams of coal, for they are conformable at whatever distance they may be asunder, is to dip at the angle I have described, and at intervals, towards the dip of the colliery. There are up-throw slip-dykes, which elevate the seams according to the size of the several faults; say 30, 40, or even more fathoms. Thus the seam goes on, being frequently cast up, so as in some degree to compensate for its natural tendency to dip. Another material advantage results from the frequent occurrence of those dykes. The Committee will perceive by this rough sketch, which is meant to describe the geological structure of the colliery, that those faults form the colliery into what may be called natural divisions, which differ from the divisions in our horizontal seam, inasmuch as we are obliged to form similar divisions by barriers of coal. Here nature has formed those divisions by those faults or slip-dykes. As the Committee will perceive, that between one slip-dyke and another, a stone drift or tunnel is driven, which communicates with those divisions. The fissures of those dykes are filled up with the *debris* of the adjoining strata, which forms them into a kind of coffer or puddle-dams, as secure as if they had been made by art.

2325. From that circumstance does not this consequence follow, that out of that ground you can work a larger quantity of coal than you can generally in the collieries in the north?—Yes, I think a greater proportion; but the advantage of this formation is, that the level or drifts of communication, the divisions, are capable of being dammed up, so as completely to separate them for any purpose that may be required, as the stopping of water or air.

2326. What proportion of the coal is worked in Whitehaven colliery in the way which you have been describing?—I cannot answer that question; I have not been there since the pillars were very extensively worked, but I believe the working of pillars is very successful.

2327. And, in fact, a very small proportion of coal is lost?—I believe so; but I cannot speak explicitly to that point.

2328. From the nature of the stratum it is less necessary to leave large pillars?—That is a different question; it generally follows under such depths; the more pillars you leave in the first working, the more you ultimately get. The Committee will perceive in the workings of any part of the seam, that dam-doors fixed in what we call the intake and outlet drifts; for there must be a double passage, one for the current of air passing in, and another for its returning; any one of those divisions may be shut up and completely separated from the rest of the mine.

2329. Is the dip towards the sea?—Yes.

2330. Are there any lateral dykes at right angles with the former one?—I believe some nearly so; but when they find it necessary they form transverse barriers of coal between dyke and dyke. Those dykes, I believe, run in something of a parallel direction, and they can leave cross barriers of coal between them, so as to form the workings into pannels, as they may find convenient.

2331. You have been asked relative to the underground work of this colliery; have you anything farther to communicate with regard to the practice which obtains there, or as regards the surface, which can be considered interesting to this inquiry?—No, I do not think I have; I should observe that I consider it to be one of the best conducted mines in the country. Mr. Peile is a very intelligent man and an able pitman, and he is assisted by his son, Williamson, who was a pupil of mine, and is a very talented young man.

2332. Are the shafts in Whitehaven bratticed as yours are?—Yes; they resort to all those measures when they are necessary, but, of course, they adopt that which is best, when circumstances will permit.

2333. Have you visited other mines in Cumberland?—Yes, I have.

2334. What mines?—I have visited the Workington mines.

2335. Are they under the sea?—They are; it is several years since I visited the Workington mines.

2336. But they go to a considerable extent under the sea?—They do; but not at all to be compared with the Whitehaven collieries.

2337. Is the ventilation in a good state?—When I was there, it was.

2338. Is the Workington mine in the same seam as the Whitehaven?—Yes, it is.

2339. Seeing the inconvenience of the brattice at the late accident which took place at Wallsend, should you consider it prudent to introduce that form of division into

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into a new pit?—I never would do it, except under the circumstances detailed in the former part of my evidence, but there is no particular system that can be positively applied to all cases.

2340. But after the shaft is sunk, you can make the separation in any way you please, either by wall, or by wood, or by iron?—No, we cannot do it very well by walls; we consider wood by far the best, because there is a degree of elasticity in it, and it is better calculated to bear the shock of an explosion than wall.

2341. But in this late accident it has not borne the shock in this way?—No, it did not; we have many instances in which it has borne the shock, and many instances in which it has not; but there is one great advantage in the wooden brattice, and that is, the readiness with which it can be repaired. This brattice that was blown out of Wallsend can very readily be replaced, whereas, if it had been of stone, it would have been a laborious task, and taken a long time to repair it.

2342. Have you ever tried the experiment of separating the divisions of the pit from top to bottom with stone?—Not entirely, but I think it has been tried at the Whitehaven, but am not quite certain.

2343. Have you ever tried the experiment of separating any by iron?—No further than sheet iron to line the timber.

2344. Should you suppose that a separation by wall or iron would be more liable to be injured than one of wood?—I think it would, because when a shock of this kind takes place, the timber brattice being formed of detached pieces, the injury extends no further than where the immediate impulse of the explosion strikes it. This is a matter of speculation or of opinion, but I think if this had been an iron brattice, instead of a wooden one, it would have been so shaken and broken that the whole of it would have gone down the pit, and would have wound itself round the shaft, and jammed itself so that there would have been the greatest difficulty in gettting it out again, so as to get down the pit within any definite period.

2345. You stated that as the temperature of the air increased, the temperature of the mine increased in proportion?—No, that is not the case, for I have found the temperature of the mine pretty stationary; I have found the temperature increased upwards of 10 or 12 degrees in the interior of the workings from the effect of the heat of animals, the lights, and the people.

2346. You have tried it at night when no person was in the mine?—I have at all times.

2347. In the evidence taken before the inquest at Wallsend, your under-viewer Mr. Atkinson is stated to have said, that the waste-man had traversed the foul drifts one week prior to the accident. Do you not consider that a more frequent inspection of those drifts is desirable?—That is not a correct description; they take it in stages; they never go in at one end and through the whole in one day, but they go so far one day, and so far another day; but those drifts are so secured that they are not subject to the casualties of ordinary falls; they are, generally speaking, either driven under the top coal, that is, an arch of coal left above-head, or they are otherwise so secured by walling the sides, and propping them, that it is almost impossible for them to get out of repair between the periodical visits of the waste-men.

2348. May not danger arise from driving the foul air-course near the pure air-course?—Not at all, because a half-inch deal brattice made tight would separate them effectually, but we never have them nearer than what we call the thickness of the stanting wall, and that varies from 10 to 40 yards of coal.

2349. But are there not many seams of coal so open in the stratification as to be an inferior barrier to half an inch deal?—No, not as regards air-pressure, because we have generally the adulterated current from the goaves, and the fresh air current running in the same direction, consequently any little defect in the separation wall is of little importance, as the pressure of the air on each side is nearly balanced.

2350. Then the density of the two currents does not differ much?—No, there is very little leakage indeed. I have had the doors between two currents thus situated opened to try the experiment, to see which preponderated, and I have sometimes found it impossible to tell which way the balance was.

2351. Do not you conceive it of importance that the waste-men should perfectly examine such doors as you have described, which are liable to have their locks

locks or staples removed?—It is their sole duty to look after such matters; and I would almost venture to say, that those doors which I have alluded to, from which the locks had been taken off, never escaped 24 hours without examination.

2352. You stated in your evidence that on the day preceding the 18th, the moment the viewer was informed that the lamps had fired, the men were ordered away from that section of the mine?—The viewer was not in charge at the time, but the over-man who was there, a person of the name of Edward Comby, instantly withdrew the men; he went in, and found that there was a considerable quantity of gas discharging, and he thought it prudent as the lamps were red-hot, according to the standing orders, to withdraw the men for a while, and in about half or three quarters of an hour he found the gas had been carried away by a current of air, and it was perfectly safe again, and he allowed the men to resume their work.

2353. You stated in what part of the mine you thought the fire must have originated; the jury have said that they cannot determine; have you had any communication recently?—No, I have not since I left home; it was my intention to examine the place where the explosion is supposed to have taken place, but the ventilation was not restored sufficiently for that purpose when I came away.

2354. The words of the minutes of evidence given by Charles Swan, are: "The boy under Hepple, who had the charge of the 'Davys,' was called Thomas Elrington, of about 13 years of age." Will you have the goodness to state to what extent Elrington's care went?—Entirely as a messenger; what I explained yesterday to be the Davy-boys, to run with the lighted Davys from the Davy-man's cabin. This boy, whenever he is called by a man, runs in with a fresh-lighted Davy, and takes the one that needs lighting.

2355. Then any inference which a cursory reader might draw from those minutes, that he was the sole judge of the fitness or state of repair of those lamps, would be incorrect?—It would be no criterion at all; the boy was the mere carrier of lamps from the colliers to the Davy-man.

2356. You are acquainted with Felling colliery?—I have not been down Felling colliery for some years, I should think not since it was last on fire.

2357. Is Felling colliery working in a very dirty seam?—I do not know; I cannot answer that.

2358. Are you acquainted with Hepburn colliery?—Not since the year 1826. I was the viewer of Hepburn colliery till 1826, when the lease expired, and I have not been down the colliery since.

2359. Is that in the Bensham seam?—No, I think not; I think it is in the main coal.

2360. Do you recollect the circumstances under which that mine last exploded?—There was a great explosion in 1805.

2361. The Committee were alluding to the explosion in May the 12th, 1814?—Yes, I know it well; there were 11 people killed, I think.

2362. To what cause do you attribute that accident?—We had not the Davy-lamp at the time; it arose in the operation of what we call changing the air; that is, turning the current from one direction to another. That part into which the current was put was very inflammable, and it was nearly the last of the air, *i. e.* the last of the run of the current in that division, so that it was considerably loaded. We found it expedient to put the best of the air into that particular place; a change in the air was therefore made for this purpose, and the first of the current, instead of the last of it, was thrown into the place, by which it would be rendered safely workable with candles. The under-viewer, with all his assistants, the over-men and waste-men, to the number of 11, I think, were down; nobody else was in the pit when this was done. Seldom any but the persons immediately concerned, and who know what they are about, go down on such occasions. Access into this place was had by a pair of main doors, as I have already described; but the fresh current of air went down one side, and returned through another opening to the east of the doors. They were all killed, but from the situation in which we found the bodies, we were quite sure how the accident had happened; they had effected the change, but had not waited long enough to allow the current of air to operate upon the inflammable air, so as to sweep it clean out; they had gone through these doors into this division, which the air-course was then in the act of cleaning, but unfortunately, not having waited long enough, it instantly exploded.

2363. In point of fact, if these men had been supplied with the safety-lamp, is there

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there not every reason to believe that no such accident would have occurred?—No such accident would have happened if they had been provided with Davys.

2364. Was the accident at Leefield in 1814 a similar case?—I do not know the particulars of that accident. I was not in the colliery, nor was I called upon in consultation, so that I know nothing of the circumstances.

2365. Are you acquainted with Heaton colliery?—I am, or at least I was.

2366. Do you remember the lamentable inundation of that colliery?—I do.

2367. Do you recollect whether any borings or exploring drifts would have been advisable, and have prevented that accident?—They were practised. It was under my management at that time, and every precaution possible was taken. The accident arose from a cause which we could not possibly guard against, a natural fissure in the rock; there were two men working in the place when the water broke in, who both escaped; one died of cholera some time afterwards, and the other was one of the witnesses before the coroner on the Wallsend colliery.

2368. Was the water tubbed back in that mine in sinking?—Yes; but it had no connexion whatever with the mine. It was an old waste that broke in from the workings, that had been relinquished in the year 1745.

2369. Then is your apprehension that allowing all the water to follow the sinking would not have drained that waste?—No, it had no connexion with it; there was a barrier of coal left, which had the effect of a dam against the waste, and we had explored it all round by drifts, and actually tapping this waste, by boring holes and plugging them again. We had probed the waste in this manner in a great many places, and so strong and firm was the coal, that at six yards distance from the face of the boring drifts, it was perfectly proof against thirty fathoms pressure of water; there was scarcely the slightest bleeding through the coal; the dam formed the shape of a half horse-shoe, or a half ellipsis; and the very last place which we were attempting to tap the waste in, was that were the unfortunate accident happened. I used every possible precaution, because I was aware of the danger.

2370. Have any of the accidents from sudden inundation which have come under your notice, suggested the expediency of allowing the water to follow in sinking mines, in preference to tubbing it back?—Where it can be drawn at any reasonable expense it certainly is the best plan, more particularly where the fracturing of the roof, by the working of the pillars below, is likely to bring the water down. In that case it is of no use tubbing at all, and it is never practised; but then I must come to another kind of colliery, such a colliery as Mr. Bell has at Willington, and other deep collieries, that have immense feeders of water lying between the coal and the surface. No engine-power that could be applied would draw that water, unless it was tubbing back; as for instance, there is one pit in Mr. Bell's colliery, called the Venture pit, I believe, which could never be sunk, on account of a large feeder of water that was met with in it.

2371. Had it any connexion with the Tyne?—Not any; one of the pits at Wallsend has also a feeder of water, 1,700 gallons a minute, at 34 fathoms from the surface, which is entirely stopped back by tubbing. The Committee may conceive the immense engine-power that would be requisite to draw such a quantity of water from a depth of 140 fathoms.

2372. Were you acquainted with the Success pit, near Newbottle?—Yes.

2373. Did that accident occur prior to the introduction of the Davy-lamp?—I do not recollect the date of that accident.

2374. In June 2d, 1815?—That was before the Davy-lamp; we did not get the Davy-lamp till October 1815.

2375. You have stated that the ordinary and unavoidable casualties in collieries occasion more calamity than explosions of inflammable air?—I think they do. I have not a list myself, but I recollect that in 1815, I took an account of accidents happening within my own knowledge; but then it included the Heaton accident, and some others. I think there were nearly 300 lives lost; it was the most fatal year I ever recollect.

2376. Immediately preceding the introduction of the lamp?—Yes.

2377. You have given an opinion of the general correctness of Mr. Sykes' catalogue of calamities?—I have. I have not had an opportunity of comparing the printed list with a manuscript one I have, but I believe it is correct.

2378. If in the last 20 years in the mines of Durham and Northumberland, even since the introduction of that lamp, it should appear that 500 to 600 lives have been lost by explosion, do you consider that the ordinary casualties have equalled that number?—I am not prepared to answer that; but I should think

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it must be very nearly equal. I think there is scarcely a week passes without a life being lost in some of the collieries. I should think the casualties are more than those lost by explosion, on the whole.

2379. Can you arrange those accidents under any few general heads?—I cannot do it without having recourse to the minutes which I keep in my minute-book for each colliery that I attend. I put the deaths down, so that I could do it; but it would require some time to make out the account.

2380. The Committee do not ask for an accurate numerical calculation of the deaths, under any specific head, but request you to state the ordinary accidents that occasion those fatal consequences?—They are so various, that it is almost impossible to draw any line. There were five people killed at Whitley colliery, about six weeks ago, by the basket slipping off the hook, and they all fell down the pit together.

2381. Is there not more than ordinary care bestowed, both by the breaksman and the banksmen, when the signal is made for drawing the men?—Yes, always; and when we consider the numerous passages that are made every day by the workmen, it reduces the risk to nothing almost.

2382. Who was to blame on that occasion?—It was supposed that the unfortunate man who fell a victim to it, instead of putting the hook, which has a spring to secure it round the corf-bow, had placed the bow upon the point of the hook, and the moment the other persons and himself got into the corf, it slipped off the hook, and they fell from top to bottom.

2383. Do you allow the men under your care to ride on the rope?—Yes; the boys always do so; they are trained to it; it is what we call topping.

2384. Do you approve of that method?—I do; it trains them to a degree of activity, vigilance and care, which they would not otherwise acquire.

2385. Have no accidents happened from that system?—I have never almost known an accident arise from the topping. I have known a boy to fall asleep with his arms clasped round the rope, and gone to the bottom of a 100-fathom pit, and the bankman took him off again when he came back, and was not till then awaked by a slap.

2386. Do the boys show any repugnance to go down in that way?—No; it is fine fun for them.

2387. Then, in ascending, it is customary to have the corf beneath, and a string of five or six boys and other persons?—No; boys only. The men seldom go in the corf.

2388. Did you ever know an accident from one of the upper boys losing his hold?—No, not losing his hold; but I have known one knocked off.

2389. What was the consequence?—He fell past the others; and I have known a boy slip down upon the knees of the men below in the loop, and been caught by them.

2390. Explain how the men go down?—There is a chain attached to the end of the rope; the common way is to go down in a loop made in the chain by hooking it up upon itself; the hook on its end being passed through a link. Two go down together in this loop.

2391. You never pass a slide over the top of the pit in that country?—No; we never do. Our pits are nearly half covered at the top by what are called the settle-boards and sliding deals, so that when the basket comes to the top, there is an inclined plane that biasses it towards the opposite side, and the moment it gets above the settle-boards, it swings almost of itself upon the tram, and requires very little effort to land it.

2392. Is it your opinion that the loss of life in proportion has been much less since the introduction of the Davy-lamp?—No, I think not; but the causes of the loss, and the circumstances of the mines, are perfectly changed; the risk is very much increased.

2393. And will continue to increase as the mines are worked off?—No; I do not think that is the cause; I think it is from the greater extent of pillar-working. The truth is, that several mines are now working, and several have been re-opened in consequence of the invention of the safety-lamp, that were deemed unworkable before; and I think I am warranted in stating that, but for the invention of the safety-lamp, there would scarcely at this time have been a single colliery in existence, to the east of Newcastle upon the banks of the Tyne, as well as in many other places.

2394. In lieu of which, how many are there?—Six, I should think, at least,

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immediately on the banks of the river Tyne, on the south side, and not less than seven below the bridge of Newcastle, on the north side of the river.

2395. Producing several hundreds of thousands of chaldrons annually?—Yes. In fact, several collieries have been re-opened by the aid of the Davy-lamp, which must otherwise have lain dormant.

2396. Do you apprehend any advantage to the public from the competition arising from that bulk entering into the market?—I cannot but think so. I should think if we were deprived of the use of the Davy-lamp, all those collieries must instantly cease. I do not think that I have any colliery under my inspection that I could work without using it less or more; consequently, if you take away the Davy, you take away or greatly cripple the mines.

2397. Neither in the county of Northumberland nor Durham?—No; I think every one of the fiery collieries are, more or less, indebted to the Davy-lamp for their existence.

2398. The Davy-lamp is in daily use in almost every colliery?—Yes; wherever danger is apprehended.

2399. As the seams are worked to greater depth, and deeper seams are exploded, its value will still be enhanced?—I should think so.

2400. Then every one of these mines in these counties are hourly liable to accident?—Not every one of them; I am happy to say that a considerable proportion of these mines have no fire in them, or at most but a very insignificant quantity.

2401. Is the Davy-lamp used in those mines?—Wherever there is occasion, but not generally.

2402. Would it not be very detrimental to the mining interest of the north of England were the coal-owners to be deprived of the use of candles?—It would be almost as bad as depriving them of the use of the Davy-lamp; because if you take away the candles, you take away the gunpowder and the produce of small coal, and waste would be so great that it would not be worth their while to go on.

2403. Are you aware whether any meeting of the coal trade generally has been held to consider the circumstances of the late accident at Wallsend?—I do not know of any except that of last Saturday week, when there was a meeting of the coal-owners called, and I was requested to attend, and I underwent an examination, and gave an explanation, as they thought it their duty to make every inquiry they possibly could into the circumstances of the accident, and I gave every satisfaction that I could.

2404. The paper that the Committee are about to read purports to be a minute of that meeting: "Coal-trade Office, 11, Eldon Square, Newcastle-upon-Tyne, 27th June 1835. At a meeting of the Tyne Coal-owners' Committee, for the purpose of inquiring into the circumstances which attended the late dreadful explosion at Wallsend colliery, after a careful examination of the underground plans of the mode of working and the ventilation, and a thorough investigation of the state of the mine immediately preceding the accident, as reported by confidential and trustworthy agents, it was resolved, That in the opinion of this Committee no blame whatever is imputable either to the general superintending mine-agent, or to the resident viewers or agents to whom the execution of the underground arrangements were confided, as they appear to have been planned with great care and judgment upon principles sanctioned by long practice, and as an unusual degree of caution had been adopted in consequence of the danger which was known to exist in working a seam, which in the district in question produces an extraordinary quantity of explosive gas. (Signed) *Robert William Brandling*, Chairman." Do you believe that to be a faithful copy of the minute upon that occasion?—I do, because I had a copy handed to me.

2405. Was this committee appointed for the purpose, or a general committee of the association of coal-owners?—It was a general committee, it was a regular meeting day of the committee, and I was summoned to give information; but that inquiry was not confined to the members of the committee, for there were others present.

2406. And on that committee there were a great many professional men like yourself?—There was a general invitation; the door was open, and any one attended who chose. A gentleman from London, I believe, was there. I know that several were there that were not on the committee.

2407. Have you heard any opinion expressed in the north as to any legislative enactment that might be the result of this committee?—Not any.

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2408. The impression upon your mind would be, that it would be very improper in the Legislature to interfere with coal-owners in the management of their mines in the north of England?—Yes; but I do not think it can be considered a subject of legislation till the cause is distinctly pointed out of those accidents, and the remedy. If there is want of discipline, or want of attention, there might be pains and penalties imposed upon those who were guilty of such neglect; but here we cannot make out that there was any neglect; it is a casualty that is incidental to the nature of coal mining.

2409. Are you aware whether, in holding the assizes for those counties, the Judges have ever stated in their charge to the grand jury the duty of the public in indicting professional men like yourself on any occasion of apparent or supposed neglect, and the duty which they should feel devolved upon them of carrying the law rigidly into effect in case of such proved neglect?—Yes, I believe Judge Bayley did; I am quite certain as to once, but I think more than once, he stated, that any viewer, agent, overman, or person having charge, being found guilty of neglect or inattention, was liable to prosecution for manslaughter, and that the law should be carried to the very fullest extent.

2410. And you feel that to be one of the protections which the law casts over the working part of the mining community, against any neglect on the part of persons in your situation?—Yes; and again our magistrates never fail to punish the workmen when they are proved to be guilty of any neglect endangering life.

2411. If the proprietors of the coal mines in the north were totally void of common feelings of humanity and care for the preservation of their fellow subjects and their workmen, would not their interest be so strong as to induce them to pay great care and attention to the working of the mines and the preservation of the lives of the workmen, independently of the feeling of humanity?—I am quite of that opinion; I will suppose the coal-owners totally destitute of every feeling of humanity, and that they considered the workmen, and all the people concerned, as mere machines of no value, their interest alone, if they had no other feeling, would lead them to avoid such casualties as this, for never does anything of this kind happen without being attended with enormous expense; and I am not prepared to say that, in this instance, it may not be totally fatal to the concern.

2412. Independently of those feelings which every gentleman must have for his workmen, the loss of property, the loss of profit, and the expenses incidental to these accidents, are such as to render it imperatively necessary for every individual connected with coal mines to devise means for the prevention of such accidents?—They are; it is always attended with enormous expense.

2413. Can you suggest any other precaution on the opening of this mine than has been adopted?—I think I have pointed out that all we can do is to keep one clean current of air, and appropriate another to carry off the inflammable air from the mine by a gas-drift, into which no naked light is ever suffered to enter; rigidly enforcing the discipline of the mine at the same time. In this case, so long as no accidental fire is set to the explosive part of the mine, all is safe; and as a proof of it, this mine has gone on for 10 years under this system with the same risk, until the fatal day came at last.

2414. Has the quantity of coal obtained by each working collier in the mine, increased in the last 20 years?—No, the men do less work; they do not work so hard now.

2415. Have not the coal-miners in the north of England given every facility to scientific men to make what experiments they please?—Yes, and invited them to do so.

2416. And have, in your knowledge, any successful results of such investigations been rewarded?—Yes; I have known various adventurers that have been encouraged.

2417. Did Sir Humphrey Davy receive any acknowledgment for his services?—He would not receive any pecuniary reward, but he was presented with a service of plate.

2418. Of value?—£.2,500.

2419. Do you recollect any other person so rewarded?—Yes, there was another person came with a number of schemes, and asserted a great number of assumed facts, which we were perfectly ignorant of before. As this man stated the wonders he had performed, and that in fact he had totally extinguished inflammable air, in Staffordshire, a committee of gentlemen was formed, who thought there might be something in what this man stated, and the coal-owners took him upon pay for

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several weeks, at five guineas a-week I believe, to see all his experiments, and he gave what he called lectures on the subject. The coal-owners deputed the Rev. John Hodgson, Mr. George Hill, a viewer, one of the most respectable viewers in our country, and myself, to go to Staffordshire to investigate the works that this wonderful man had done. We went there and examined the scene of his performance, as he had stated he had done such wonders, but we could find nothing he had done as to improving the system of ventilation. The only alteration he seemed to have made, was substituting sheet-iron air-spouts instead of wooden boxes; that was all that we could make out of his performances that had any meaning in them.

2420. In anticipation of any beneficial results, was any reward offered to him?—He was kept on pay for some time at five guineas a-week, until every one was satisfied that his schemes were visionary.

2421. Did any society offer him any medals?—I believe the Society of Arts did, but none in our country.

2422. Did not Mr. Stevenson receive some reward?—He did.

2423. What was it?—I do not know, but I believe it was 1,000*l.* I am quite sure that on every occasion, when anything feasible has been presented to the notice of the coal-owners, they have given due attention to it.

2424. Do you know whether the Society of Arts, in London, has acknowledged his services in any way?—I believe the Society of Arts have bestowed medals.

2425. Are you acquainted with the coal mines in Scotland?—Yes, some of them; I have been in the coal mines in Lothian and Fifeshire.

2426. Are any of those mines subject to fire-damp?—They are a little so, but so trifling that it is not worth while naming them.

2427. From your own personal observation, are the precautions taken equal to the risk?—They are, for the risk is nothing in those mines; you have to search for gas as a curiosity in them.

2428. Have you examined any mines in the West Riding of Yorkshire?—Yes.

2429. Are you aware whether any of them are explosive?—They are, but in a very slight degree.

2430. Have you seen the returns furnished by the owners to an order made by the House of Commons in the course of last session?—I have not, but I would observe, that in many of the collieries having the least possible quantity of fire-damp accidents sometimes occur; for there is not a sufficient quantity of gas to put the men upon the alert, and to induce them to resort to the proper measures for the expelling it.

2431. In the neighbourhood of Bradford or Halifax what is the state of the mines?—I have not been in the collieries in that neighbourhood, but I have been in the collieries in Leeds and Sheffield.

2432. What are the seams in the neighbourhood of Leeds?—There are three seams in the neighbourhood of Leeds. In the Rothwell Hough colliery, for instance, there is a three-feet seam, a four-feet one, and a six or seven-feet one.

2433. Are all those seams explosive?—I should think less or more so, but I have seen nothing amongst them that I would call a fiery coal; but there is scarcely any seams of coal which have not some gas in them.

2434. Are the safety-lamps used in those mines?—Yes; the moment I see what provision they make for ventilation, I can tell whether it is a fiery coal or not. In many collieries they provide the means of ventilation merely for respiration, but they do not employ it as a mechanical agent to carry off by its impulse the gas.

2435. In case any explosion takes place in such a mine, is it not fairly attributable to neglect of the precaution of due ventilation?—I should think it must, because, if there was a tenth part of the quantity of ventilation put into such collieries (I do not speak of any particular colliery, because I am not sufficiently acquainted with them) that we employ, it would be amply sufficient to keep them in a safe state.

2436. Do your observations apply to the mines about Barnsley?—I have not been to Barnsley; I have been only to the neighbourhood of Leeds, Sheffield, and Rotherham.

2437. Are there any peculiar characteristics in the mines in the neighbourhood of Sheffield?—Nothing in particular, but on the whole they have rather a greater inclination than our beds, particularly at Rotherham; they rise at a great angle.

2438. Are those more liable to the effusion of gas?—I think not; there is a very good reason why they are not so; the ancient workings have commenced at the crop or surface, and they take a slice or web down so far, and the next winning in succession

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succession takes another slice, and so they go on slice by slice, consequently there is always an outlet for the gas at the surface.

2439. The gas being lighter than the atmospheric air, finds an outlet?—Yes.

2440. Have you visited the mines of Lancashire?—I have.

2441. Ashton coal-field?—No, but I have been in the Black-rod colliery.

2442. Near what town is that?—Near to Wigan.

2443. Many of those mines are very explosive?—I believe they are; but I am not prepared to say whether explosive from the quantity of gas they contain, or from the want of ventilation.

2444. As that is a question which immediately interests the Committee, you do not feel prepared to give a decided opinion?—I do not, because it is many years since I was in those mines, and I do not know the present practice.

2445. Nor whether the lamp is in use?—Nor whether the lamp is in use.

2446. Have you visited the mines in Staffordshire and Derbyshire?—In Staffordshire I have, but not in Derbyshire.

2447. Have you visited the Newcastle-under-Lyne district?—No; it is the Dudley district I have been in.

2448. Can you give the Committee any information as regards the Dudley district?—I can. I consider their mode of ventilating their thick seam very good in principle. I must beg to be understood as speaking of the thick seam, the 40-feet seam; the fact is, that it is a great number of seams collected together; it appears as though a number of seams were collected together, and only divided by thin layers of what we call band. With regard to the ventilation of those mines, I consider their system by discharging the gas round the top drift very complete, as the great height of the seam is favourable to that plan. The work is carried on in chambers, called sides of work in these particular districts, or large chambers: the system of ventilation is effected by putting a top drift round something like the cornice of this room, and there are small apertures made between these drifts and the top of the chamber, by which the gas is carried off into the top drifts. The opening where the horses enter at the floor of the chamber to take away the coals, serves as an inlet for the atmospheric air, which naturally ascends and passes into the top drift by the little holes already described, and carries off the gas with it.

2449. So that, in fact, the great height of those seams renders the operation of ventilation easy?—It is easy under those circumstances.

2450. Do you know whether they are liable to great contingencies and accidents by the falling of the roof?—They are, I believe, not so much from the falling of the roof, as from the falling of the coal. I believe that accidents are pretty frequent. The first process in this working is to dig out five or six feet at the bottom of the seam, but leaving a single strong pillar in the middle of the great mass of coal, which pillar they call the "man-of-war:" it is a square pillar, left in the middle of the side of work, about four or five yards square. It supports the immense mass above of about 30 feet thick, like a pillar or pedestal of coal. It is called the "man-of-war." The workmen then dig upwards all round the mass, making foot-holes on each side as they proceed upwards, forming a narrow niche, barely sufficient to allow them shoulder-room to get to work in. It frequently happens, (I have not been in to experience it myself,) I am informed, that one of the lamina or leaves of coal will give way and crush the bodies of those men in the niches, and that lives are lost in that manner. After they have proceeded to a certain height in this manner, the last operation is to remove the "man-of-war," which is done by transverse passages driven through it horizontally; it then stands upon four slender legs, or feet, which sometimes yield, and are crushed from the weight above; but if that should not happen, the fall of the mass is effected by a kind of battering-ram, which the workmen strike against the legs of this man-of-war, till they nibble and weaken them, so that they give way to the pressure, and down comes the mass altogether. I have seen one of those masses immediately after its fall from that operation. This is the Staffordshire mode of working this thick seam.

2451. Was your impression that the safety of the workmen was sufficiently consulted in that mode of working?—I think it was, as far as the nature of the work could admit; every care seemed to be taken, by putting in struts and stretches, &c. and all that kind of thing, which colliers understand; but, at the same time, casualties will happen under that hazardous kind of employ.

2452. What quantity of coal fell at once?—I cannot remember; but it was enormous. The regret I felt was to see such enormous waste made: it would

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have been much better if the seam had not been above a fourth or a fifth of the thickness, as respects the effectual working of the coal.

2453. Have you any remark to make upon the small seams?—I was not in any of them.

2454. Have you visited the coal mines in North Wales?—Yes; I have been in the Baggàlt coal mines in North Wales.

2455. What is the depth of those seams and the thickness of the beds?—I think there were three of them, varying from three feet and a half to seven feet.

2456. Was there any quantity of foul air in those mines?—There was; but not considered to be of any great importance. It was nothing but what was considered to be quite controllable by the ventilation.

2457. Are you aware whether life has been frequently lost in those mines?—Yes; I have heard so.

2458. Do you conceive that, under such circumstances, ordinary care might have prevented such accidents?—I think it might; but in some of the Midland collieries, I believe, their air discipline is not attended to as ours is, the management of the ventilation is pretty much left to the colliers themselves. They do everything underground; they attend to the ventilation, and lay their own ways, and dig their coal, by piece-work.

2459. In point of fact, the work is conducted in a slovenly manner?—It is done by the colliers, not under that strict system of discipline and inspection that ours is done; indeed they do not require it.

2460. In consequence of the mode of letting the pits, the executing of all that sort of work is left to the colliers?—Yes, in a great measure; but I would beg to be understood as giving all this information with great caution, because I am not in the habit of visiting those mines. I have occasionally done so, and I speak from the observation that I have made at the short intervals I have been there.

2461. The Committee understand your evidence to be that of a professional man making but a casual inspection of the mines?—No more.

2462. Do you know whether the safety-lamp can be considered as in general use in any of those mines?—I should think not; as far as my observation goes it seems to be considered more as a matter of curiosity to explore particular parts, than as an instrument of ordinary use; and, generally speaking, I have observed the Davys in such places but in very indifferent order, dirty, and not at all in good keeping.

2463. You have mentioned one mine, the Baggàlt mine, is that the only one you have inspected?—It is the only mine I have been in, in North Wales.

2464. Did you notice the method pursued in those mines of drawing the work to bank?—Yes.

2465. The chain on arriving at the bank passes over a pulley called the jaw-mill?—I do not think that was practised when I was there.

2466. Did you when there hear of frequent accidents occurring from men becoming entangled with the machinery?—No, I did not; that was not mentioned to me.

2467. You are aware that it is customary in most mines to attribute accidents to the carelessness of the workmen; do not you think that the carelessness of the employers, in not laying down adequate rules for the conducting of their mines, may also in many cases be culpable?—I do not know. I have not sufficient acquaintance with the mining discipline of other districts to know that.

2468. Cannot you conceive the necessity of men so employed having sufficient rules in print or in writing placed before them?—I think it might be advantageous. Our plan generally is to chalk upon the doors underground, which are not to be entered except by official persons. If it is a prohibited door, there is generally written in large letters on it, "No admittance here," or something of that sort; and we have also signals by putting cross timbers in prohibited places, and every collier knows that he is not to enter if he sees such a token.

2469. With regard to South Wales, have you any knowledge of the mines of Glamorganshire in the neighbourhood of Merthyr?—I have been in none of them except Mr. Guest's.

2470. Are the seams of coal of great thickness?—Of great thickness, and very good beds they are.

2471. Do they enter by the adit, or by the shaft?—By adits principally.

2472. Did you observe any difficulties in the ventilation of those mines?—No; they are well ventilated.

2473. Is the generation of gas very moderate?—I think very moderate; we could discover scarcely any place which contained gas.

2474. In consequence of which no explosions take place?—I have not heard of any.

2475. Have you visited the mines in the Forest of Dean?—I have.

2476. Are there any circumstances of interest to this inquiry connected with these mines?—I think not; they are exceedingly simple, they are worked by adits generally, and I think scarcely any gas is made; they are above the sea-levels, and they are mostly crop-working mines.

2477. You have mentioned sea-level, is it any part of your theory, as regards gases, that the inflammable air is not found above the level of the sea?—No; I have no theory upon the subject, but I go upon what I have observed. I have observed that there is less gas in the seams of coal lying above the sea-level, than in those lying below it.

2478. Have you visited the mines recently opened in Leicestershire?—No.

2479. You are not acquainted with the Moira seam?—No, I am not.

2480. Have you visited the metallic mines in Cornwall?—No, never.

2481. Did the mode of working the thick mine in Staffordshire engage your particular attention?—It did, inasmuch as I felt a great regret that so small a proportion of so magnificent a seam was obtained.

2482. Did it occur to you that any better mode of working that mine might be adopted?—It did; but I am afraid that in any improvement in the mode of working, if one inconvenience is remedied, others might be incurred. The great difficulty of adopting any other mode of working arises from the immense height of the roof; you cannot have the advantage of propping, therefore the roof ought to be the last thing bared; and they are subject also to the ground fire, the slack, when left under ground, if air is admitted into it, spontaneous combustion takes place, and that adds very greatly to the difficulty of improving the mode of working that splendid seam.

2483. Have you met with any case of spontaneous ignition underground, in the north?—No, except in the Berwickshire district; but not with us. After creeps I have observed extreme heat evolved by the pressure, but never amounting to fire.

2484. You state it as a fact, that the accumulation of small coal in the mines in the north, has never been known to ignite underground?—I have never known it ignite spontaneously, but I have frequently known it set on fire by explosions of inflammable air.

2485. As a general question, does anything occur to you to mention to this Committee as involving the comfort and welfare of the mining population of this kingdom?—No; if anything had occurred to me upon any occasion, I should have been too glad to have mentioned it; but I feel considerably discouraged, inasmuch as we cannot control casualties. I can only say, in this unfortunate mine I had taken every possible pains to do everything which I thought would render it safe. I was quite aware of the great hazard, and I thought that we had brought it to that point, when it was simply a question between the Davy-lamp and explosion, and that our sole danger centred in an accident to a lamp, or, what I could scarcely suppose, some wilful act of negligence. I therefore, in that view, cannot say that I possibly could do more than I have done. I considered the mine to be perfectly safe, so far as depended on the means we pursued, and I think it will be clearly ascertained by and by, that it has happened from some unforeseen or extraneous cause over which we could not have any control, and not from anything depending upon the ventilation.

2486. Do you now think, after the experience of the accident, that any precaution was omitted which might have been taken?—I do not; for I divided the field of coal into districts, shortened the runs of the air currents, and divided them so as that all the gas from the dangerous parts was carried away by the gas drifts, through the dumb furnaces, and discharged up the pits into the atmosphere. The clean currents in which candles were used, were carried off by separate channels to the burning furnaces. The currents, therefore, which were liable to be laden with gas, were carried off into the atmosphere, without the possibility of their ever coming in contact with naked flame at all. I do not, therefore, see anything more that I could have done.

2487. It would of course be a great advantage if the mines could be lit

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without candles or lamps at all?—I do not know that, because stationary lights are not convenient.

2488. Have you been made acquainted with Mr. Gurney's plan of lighting mines?—No, I have not; but I have seen Mr. Gurney's light.

2489. Supposing that light could be so conveyed as to pass into every part of the mine and give a perfect light to the workmen, would it not effectually prevent those accidents which now occur?—In giving an answer to this question, I will first assume it to be possible, that neither twists nor turnings, nor stoppings nor doors, nor ascents nor descents, nor any underground impediments whatever, will impede the application of the light. We will assume that we may get a light direct to any point we wish, but that light having to go in narrow passages, I should presume that the pencil of rays would be confined to that particular passage; the question then is, is that light of Mr. Gurney's not too intense for the eye to face it, or for the horses to face it. From the experiments that I have seen tried, Mr. Gurney's light appears to me to be so intense that no eye could bear to face it, if confined in a narrow passage; but then, again, perhaps it might be modified by coloured glasses. Supposing all this done, and that a light could be thrown in every direction, and through every impediment of doors, stoppages, and so forth, I think it might be substituted in all the lines of passage for the lights we at present employ; it would go to the withdrawing of all candles or lamps so far as it could be conducted; but in the immediate workings, where the colliers are digging the coal, and especially in what we call dirty seams, where there is a great quantity of foreign matter, as slates and braces, &c., which have to be taken out of the coals, I should scarcely think that any general light would answer the purpose; each individual, I conceive, must have his own light for that particular purpose. I do not know whether the dust and smoke that is very often in pits, especially in the shafts, would be an impediment. I believe Mr. Gurney's light penetrates fog to a very considerable distance, and perhaps it might have the power of penetrating the dust and smoke in the mine also. I would beg to state, that the principle of reflection is by no means new to us in the mode of carrying light into a pit. Before the introduction of the Davy-lamp, and after the danger of the steel-mill was throughly ascertained, we had recourse to mirrors, a discovery that was made by accident at Wallsend colliery, in the first fatal accident which occurred there in the two original pits by explosion in the shaft in 1783. In the clearing out of those pits again several fatal accidents happened from the steel-mill; the people were perfectly ignorant of the effect of the spark from flint and steel, and consequently they had the most perfect confidence that it would not fire; however, explosion after explosion took place, and life after life was lost, till at last a person using a steel-mill when this took place distinctly saw the gas fire from his mill, and indeed two cases of that kind occurred before people could be convinced that the gas would fire from the spark of the steel-mill. After that, various expedients were resorted to for giving light; phosphoric lights, fish in a state of incipient putrescency, and various other schemes were tried, but nothing proved effectual. It happened one day, however, that whilst a carpenter was working upon the top of the sheer-legs, as we call them, which are raised over the mouth of the engine-pit, with a new hand-saw, he turned it by accident to such an angle that it reflected a pencil of the sun's rays down the shaft. The people who were working there were alarmed beyond measure; they thought it was another fire; they thought the flash of the rays from the saw was an explosion. On investigation the true cause of their alarm was discovered; the bright hand-saw had operated as a mirror, and this gave the idea of the application of mirrors. I have used mirrors in repairing a shaft after an explosion. A person was placed upon the top always when the sun was shining, and the mirror was placed at a certain angle so as to throw the rays of light down the pit; they never attempted to do it further. In one case, in a pit of 120 fathoms deep, in which we were thrown into great difficulties to get the engine-work put right again, it was the Percy mine colliery, I resorted to the expedient of the mirror in repairing the shaft, and the light so thrown down was sufficient to do the work while the sun was shining; but there was so much inflammable air arising from the workings below at the time, that we durst not use any of the lights we had at that time, and therefore used the sun's rays in the manner described. After we got to the bottom, and began to make progress a little, we got into the dark; I tried the experiment of reflectors; I took a smaller mirror, and caught the pencil of rays from the surface by the first mirror, and

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and I threw the light with one glass to some distance; I could govern it so as to throw the rays of light upon a nail-head, or any minute object of that kind, but I could not with any effect get beyond the first angle; the rays became so feeble, and the pencil so small, it diminished so rapidly, that I could make no use of it beyond a very few yards. That is the full extent of what I know about reflected light. Now, I presume, that if this light of Mr. Gurney's were so applied and extended, it must come to something of that kind.

2490. But the greatest obstacle to its introduction you apprehend to be the difficulty of bringing it to the respective boards in which the men are at work, and which are the points of danger?—Yes; there are so many different places in which the individual has to work during the course of the day. In this very pit that exploded, when all the men were at work, there were nearly 100, divided into four divisions, and none of them were working more than from two to four together, so that it would require an immense diffusion of light to light them all.

2491. Can you conceive the light applied in any way in which the shade of the workman would not be invariably upon his work?—If it was applied behind him, the shadow would be thrown upon his work.

2492. How would it be practicable to place the light in advance of him?—If it is to be done by reflectors, it might be done by placing the mirrors in a proper position, whatever the angle of incidence might be; but, of course, it would require proper apparatus to accomplish all this. We had very great difficulty in conducting the sun's rays, as the slightest movement of the mirror would throw the pencil quite out of the circumference of the pit. We had scaffolds at the top, and the man lay with a proper support for his chest; the glass was fixed in a frame upon a pivot, so that he was constantly obliged to watch the movement of the sun, and accommodate the position of the mirror to it; but I readily conceive that the advantage of Mr. Gurney's light would be, that it would be stationary.

2493. But you have no difficulty in ventilating the vacant ways and head-way courses, so that the point of danger is not reached unless the light is absolutely conveyed into the boards?—No; we can command our ventilation in any direction, and have no difficulty about that. We always have contrivances and expedients by which we can carry the current in one direction or the other; by crossing the currents we can do almost anything with them; indeed, I would say that we can ventilate every part of the mine effectually, and put it in a safe state, except in those parts where the pillars have been removed, and into which we have not the means of directing the current of air so as to sweep the gas out of them.

2494. Taking precautions against blowers from the roof, or eructations from the floor?—Yes; but they must be carried off. We can take no other precaution than carrying them off and keeping the men out of the way till they are disposed of. I have said nothing about the mixtures of air in the former part of my evidence, but I must inform the Committee, that immediately to the leeward of a blower, though for a considerable distance the current may be highly explosive; it often happens that after it has travelled for a considerable distance in the air-course, it becomes perfectly blended and mixed with the air, so that we can go into it with candles; hence, under the candle system, before we had the use of the Davy-lamp, we intentionally made "long runs," for the purpose of mixing the air, which might have to be passed through a burning furnace. Far-travelled air would bear an amazing large top upon the candle, before there was any real danger of firing. Before the introduction of the dumb furnace, our wish was to give these returns as long runs as possible before they came in contact with the flame, as it was our greatest protection against the return air firing on the furnace.

2495. Then in fact the specific gravity of inflammable gases being lighter, prevents their admixture with the atmospheric air up to a considerable extent, does it not?—No, they mix with much more facility than might be imagined. The inflammable air, if it is in a quiescent state, or immediately from the mouth of a blower, is generally found at the top, but the current of air, as it passes along, forms eddies at every turn, which soon mixes the two airs. There are thousands of those eddies, and every whirl the air takes at an eddy mixes the gas with it, the longer the more intimately, so that in travelling any distance or length of run, as we call it, instead of finding the air stratified with the gas above and the air below, we find it one regular mixture from top to bottom, and if it were explosive at all, it would as soon fire at the bottom as at the top.

2496. Have you any reason to suppose that fire-damp consists of naptha and

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atmospheric air?—I have no pretensions to chemistry, and never attempted an analysis of the gas, I have always taken the opinion of those who were competent to analyze it. I think it has been stated lately that Dr. Thompson had discovered that chloride of lime would destroy the inflammable power of the gas; but a chemical friend of mine, Major Emmett, of the Royal Engineers, got some of the gas from the pipes at Wallsend, and showed me an experiment upon it, by which it did not appear to have the least effect whatever, the gas was just as explosive when mixed with it as before.

2497. Is there an evolvement of carbonic acid gas to such an extent in any of the mines as to prevent the burning of the lamp?—Yes, frequently, and candles too; that is what we call stythe. We generally find that in the old workings; it is rarely if ever found in the new workings of a coal mine.

2498. Where it is necessary to expel it, what are the means adopted?—Nothing but strong and powerful ventilation, and we find it more difficult to move than the inflammable air.

2499. When the workmen are overcome by the unexpected presence of carbonic acid gas, do you conceive that adequate care is taken to produce re-animation?—Yes, I conceive so, but the effect is as instantaneous in some cases as gun-shot. I have known a man, by merely putting his head into a hole in an old working where stythe was, to drop dead as though he were shot, and I have inquired of medical men the cause; they say that the lungs are found in a state of absolute collapse, and that inhaling the gas must have thrown them into that state in an instant. Indeed it must be something of the kind, from the very sudden manner in which it inflicts death; but at the same time we both travel and work in certain mixtures of it to a great extent. In my own experience I know that it may be breathed when no flame will exist in it, and I have had occasion frequently to travel in a mixture of this kind when a candle would not burn and steel-mill give hardly any sparks.

2500. Have you any physical indication of its presence?—Yes, oppressive breathing, but not by any means dangerous while the steel-mill will elicit any sparks.

2501. What are those indications?—Oppression at the chest.

2502. A witness on a former occasion stated his apprehension of the presence of sulphuretted hydrogen in some of the mines; do you agree in that suspicion?—Not of my own knowledge. I think it is possible. I believe I have seen a case of it, but I really could not positively say. We can always detect the presence of carburetted hydrogen by the appearance of the candle, what we call the show upon the candle, and before the introduction of the Davy-lamp we were much more expert at this sort of test than we are at present; for the introduction of the Davy has taken away the necessity of paying so much attention to the show upon the candle as we did before.

2503. Are the workmen, in cases of sudden death, acquainted with any professional rules similar to those issued by the Royal Humane Society for proceeding to recover animation?—I think they are. Emetics are found the most efficacious to give motion to the diaphragm. On the post-mortem examination of two of the bodies at Wallsend, Mr. Macintire, the surgeon, informed me that he had found the stomach of the overman Christie, who had been 26 hours dead, in a state of gangrene, precisely the same as if he had taken arsenic; and I have seen many, I may say scores of people, that have been recovered from a state of suffocation by after-damp, and the most efficacious mode of treatment appeared to be very strong emetics, I presume to clear the stomach of that load of poisonous matter, and to produce general action through the system.

2504. Has that suggested the propriety of such medicines being always at hand in the mine?—Yes; and Mr. Macintire told me that it was extremely satisfactory, the examination which he had made of two of the bodies, inasmuch as it quite confirmed the ideas which he had previously formed, and therefore proved that his previous treatment had been correct.

2505. Then the Committee is to understand that there are individuals in readiness to administer such a medicine as the circumstances should call for?—Not always; but in this case of Wallsend, I believe, the medical gentleman was upon the spot in a very short time. Indeed, there were surgeons living upon the spot, if medical aid had been required at the moment.

2506. The allusion in the last question was to accidents from carbonic acid gas?—They very seldom occur with us in fiery collieries, because our ventilation is generally

generally so good, that, if it did exist, it would be expelled, or kept in a respirable state. Most of the accidents from carbonic acid gas occur in the mines which do not abound in fiery gas.

2507. Are you aware that the fact is known generally, that the administering emetics is the readiest remedy?—I think all medical men are aware of it.

2508. And are the overmen and workmen aware of it?—Yes, I think they are; for if there is no other means at hand, they pour melted butter and warm water down the throat of the sufferer. The women understand these things very well. They had a barbarous practice a few years ago, which I think is now exploded; it was galloping them about in carts over the roughest ground that could be found; they thought that was a good mode of treatment, but I have little doubt that several people have been killed by that treatment. After galloping them about over the ground as I have described, the next thing was to dig a hole in the earth and put the face into it, from an idea that there was some virtue in the smell of the soil, or that some absorption, or something or other took place, that tended to restore the patient.

2509. Do you think that if men of science, not connected with collieries, were induced to visit the mining districts, in order to inquire into the causes to which accidents were attributable, it would lead to any useful results to the objects of this Committee?—I do not know but it might, for I think it is from science, or rather from genius, that we have anything more to expect; I do not know that we can have a more marked instance than the visit of Sir Humphrey Davy. I do not think that we are the persons likely to discover any new light; I would rather look to some person of genius or science who is not an immediate collier; and I think it is more likely that something might be elicited in that way, than by those going on daily in the working of the mine; and I think all the coal-owners in our country would be most glad if anything could be suggested, and would cheerfully give every facility that they could, to such inquiries.

2510. In fact, the most important discovery that has been made, has been by a gentleman not in the business, who has visited your districts?—Yes; and I think, generally, the greatest improvements have been made in most businesses by people not immediately concerned in them.

[*The Witness delivered in Copy of Informations of Witnesses, &c., and the same was read, and is as follows:*]

Northumberland. { INFORMATIONS of Witnesses severally taken and acknowledged, on behalf of our Sovereign Lord the King, touching the Death of *William Craster*, at the *Wallsend Colliery Office*, and from thence adjourned to the *School House* at *Wallsend*, in the Parish of *Wallsend*, in the County of *Northumberland*, on the 22d day of June, in the Year of our Lord 1835, before *Stephen Reed*, Esquire, one of the Coroners for the said County, on an Inquisition there and then taken on view of the body of the said deceased, lying dead in the said Parish; (the said several Witnesses having been first duly sworn) as follow; to wit,—

John Buddle, of Wallsend, in the county of Northumberland, esquire, being sworn, proceeded to give the following account of the colliery, and illustrated his description by references to a large plan of the workings, without which it is impossible to convey any exact idea of their nature and extent. He stated that, between 20 and 30 years ago, he devised a plan of ventilating coal mines by what he called double air-courses, which consisted simply in driving a current of air down one shaft and up another by rarefaction. It required just 14 times the quantity of atmospheric air to be diluted with one of foul air, to enable the latter to bear a naked flame without exploding. The Bensham seam of the Wallsend pit emitted a great quantity of foul air, and of course required the intromission of good air to 14 times the extent. To effect this, the best system of ventilation was required and had been adopted. The means taken were to produce rarefaction by furnaces when the air was not sufficiently inflammable to fire at naked flame, and thus carry the adulterated air up one air-shaft by driving a current of atmospheric air down another. Where the emission of gas is so great that the introduction of a flame would cause instant explosion, as is the case with old workings, currents of air are carried along the face of these workings by means of what is called the gas drift, or dumb furnace; and these currents bear the gas along with them as it oozes out from the front of the coal. Thus the air which is safely accessible to naked lights, goes to the furnace and by rarefaction is carried out of the mine, whilst that which would fire on the introduction of a flame is carried off by a distinct drift without coming in the way of flame at all.

The colliery comprises four shafts, one of them double, and extends over an area of 105 acres. Thus five pits cover 105 acres, which is only about 20 acres to a pit; and these are ventilated by three downcast and three upcast shafts. Whenever a place is doubtful the naked light is not permitted to be taken there. There are four divisions of the colliery now working, in two of which, those called the pillar divisions, Davy-lamps are used; and

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in the other two, called the whole (or unwrought) coal divisions, the work is carried on with candles. In the latter, the air is so good that candles may be safely used; and when Davy-lamps are used no explosion can take place in the former, but by some sad neglect, or accident, or inadvertance. Should the lamps become heated, this operates as a caution to the men, and they are directed to retire from such places as early as possible. Their art only extended to the taking off the gas by means of drifts or air courses; and all they could do was to make the mine safe in one place for naked lights, and in the other for Davy-lamps. No communication can take place between the workmen who use candles and those who work with Davy-lamps. They are divided by stoppings, or walls of brick or stone, and are about 100 yards apart. By this method of dividing the works, it is hoped that, should an accident occur in one division, its consequences may not extend to any of the others; for this can only be done by blowing away the stoppings. There is an immense gasometer which feeds a flame by means of a pipe at the C or village pit, at the rate of 11 hogsheads per minute; and if the fire had reached to that magazine the effect would have been like that of an earthquake. The village might have been destroyed by the explosion. He (Mr. Buddle) knew no more than a child where or how the accident originated. Up to that morning he had supposed it to have taken place in the east pillar division; but when they had got through the obstruction caused by the blowing away of the brattices they found this could not have been the case. The bodies found there had died from suffocation by the after-damp, and had the shaft not been choked up, and the air stopped thereby, it is probable that not over 20 or 30 lives would have been lost. So deliberately had the workmen left this part of the mine, that each boy had his Davy-lamp, and one man, who seemed to have driven the lads before him, had brought away five. This conjecture as to the origin of the fire proving unfounded, he could not conceive where it had commenced. The locks of the gas-drift doors had sometimes been taken off; and God only knew whether something of the kind had taken place on this occasion, and thereby led to the explosion. They could say, almost with certainty, that it had not not occurred in any of the divisions where the men were working.

Mr. Buddle, in continuation, proceeded: I have been employed 43 years at Wallsend colliery. The colliery had been wrought about 11 years before I knew it. Since I knew the colliery the main coal has been wholly worked, its thickness is from six to seven feet. The next seam that was proved and partially worked is the metal coal seam, three feet in thickness. The succeeding seam is the Bensham seam, now in the course of working, it is five feet six inches in height, and was first opened in 1820. This seam at the pit where the explosion took place is between 140 and 150 fathoms from the surface. Though it is not a general principle, yet, with respect to Wallsend colliery I have found that the deeper the seam is from the surface the greater quantity of hydrogen gas is generated. The present workings of the Bensham seam extend to about 100 acres. The coals are drawn from one pit only, the G pit, which is a double pit, that is, the coals are drawn up on each side of the brattice which divides the shaft. There are five ventilating shafts, three of which convey the atmospheric air into the seam, and the other two carry it off; the former being the downcasts and the latter the upcasts. The Bensham seam has always been known and considered as a dangerous seam, and requires the utmost care to keep it in a workable state, for which the most approved system has been adopted and pursued. I consider that the shafts for ventilation are amply sufficient for the purpose, as they have been found to be up to the present time. And, from the experience I have had, I believe that this accident has not arisen from any defect in ventilation. The Bensham seam, as I have before stated, is about five feet six inches in height. There is a band runs through this seam of coal which they are now working; it extends in the shape of a wedge, and is at one place about 16 inches thick. Eastward it nearly disappears altogether. The band lies about two feet 10 inches from the roof. The men work in different districts for the purpose of dividing the risk, so that if an explosion takes place in one district it might not extend to another. The men that were working in the G pit were in four divisions, one party was working full 500 yards from the shaft of the G pit where an explosion took place. This place was the most dangerous part of the pit. This particular part was at the extremity of the east boundary, and as the coal was wrought and taken away the roof naturally fell in from pressure, there being no pillars left to support it. These places are called the goaf, or void, consequently a great quantity of foul air or hydrogen is generated there. A separate current of air is directed past the face, or in front of this goaf, to carry off the gas that is emitted from it into the gas drift, by which it is carried into the upcast pit, which is 2,000 yards from the place where the gas is generated, as above described, and without being allowed to come in contact with the furnace which is used for rarefaction. Another party of men was working upwards of 1,000 yards from the shaft of the G pit; both these parties were working in the pillar. Another party was working in the whole mine, where the coal had not been wrought before, about the same distance from the G shaft as the last. And the fourth party was working about 900 yards from the G shaft, in the whole mine also. In all these workings there exist inflammable air, more or less; which, as regards the pillar working, is carried off by separate currents of air into the gas pipe or dumb drift, whilst the inflammable air from the whole workings is carried off by its appropriate currents to the furnaces in upcast shafts. The men who were working in the pillar divisions were working with Davy-lamps. Those who were working at the whole coal were working with candles; but even here, whenever any danger is apprehended, the candles are withdrawn and the Davy-lamps substituted. One of the division of pillars was near to or in the vicinity of the division that was working the whole coal. The two places were

were upwards of 100 yards apart, and were effectually separated by a course of substantial stoppings by which the air courses already described are kept separate and independent of each other. If any of those stoppings are injured no serious danger can occur, as the current of fresh air would preponderate and pass off with the adulterated current.

The last time I was down the colliery, previous to the accident, was about three weeks ago. I then found everything correct, and the system of ventilation in perfect order in all its details.

The daily details of the ventilation is committed to Mr. John Atkinson, viewer, with his overman, deputy overman, wastemen, and others, who are daily down the pit, and on all other occasions when there is considered a necessity for it. I was down the pit after the accident happened on Friday morning. The object was chiefly to devise some plan to recover the bodies of the workmen. The first body I came to was that of a deputy overman, which was as far as I could at that time go with safety. This man appeared to have been making endeavours to escape, being found near to the place he was employed at. He seemed noways burnt, but must have died of suffocation by the after-damp. As far as I have been able to explore, there are no indications to show where the explosion first took place; but, as yet, there is no reason to suppose it took place in any of the working divisions. The reason that candles are used in working the whole coal is, that it is necessary to blast the coal with gunpowder, which is rather a means of safety than otherwise, because it at all times proves the efficiency of the ventilation; if it was not so, gunpowder could not be used.

Examination of *John Buddle* continued after an adjournment, 23d June 1835.

I have already observed the Bensham seam of Wallsend colliery abounds with inflammable air; in order that an idea may be formed of the quantity discharged, I take, for example, the quantity which is now in a state of combustion at the top of the gas pipe of the C pit. This stream of gas issues from a detached portion of the workings of about five acres in area. The quantity as gauged issuing from that pipe is 11 hogsheads per minute, and is constantly burning. Supposing that the gas which is conveyed from the workings by this pipe was suffered to discharge itself through the workings, it would take at least from 150 to 160 hogsheads per minute of atmospheric air to dilute it below the firing point, so as to allow of its being carried through the fire of a furnace. I am of opinion that those three downcast shafts are sufficiently ample to convey a sufficient quantity of atmospheric air to render the workings safe. But the working in the broken or pillars is always dangerous, and cannot be worked without the aid of the Davy-lamp. About 700 yards from the broken at the east side of the mine, and about 250 from the G pit to the west of it, a portion of the mine has been wrought and other parts crept or fallen in; in these places a considerable quantity of foul air exists, and to prevent the workmen having access to these old workings they are built up with strong stoppings, except two doors for the wastemen to enter, whose duty it is to travel the gas pipe, or dumb drift, for the purpose of keeping it free and open at all times: which doors are kept constantly locked, but when the wastemen have occasion to go through them; on those occasions the wastemen have Davy-lamps.

In 1821, when the Bensham seam was first opened, the dangerous nature of the seam was soon discovered by the fatal accident which took place on the 21st day of October in that year, and showed the necessity of adopting the most efficient mode of ventilation that could be devised. At that time only one pit was sunk to this seam, the workings were therefore suspended until other pits were sunk, and until progressively five in all were put down to this seam, as already stated, and the system of ventilation was brought to its present improved state.

John Buddle.

John Atkinson, of Wallsend, in the county of Northumberland, being sworn, saith: That I am under-viewer at Wallsend. Have been three years and a half in that situation. My duty is to see the workings kept in proper order, and am down the pit nearly every day, sometimes twice a-day. Came up from the pit last Thursday morning (the day of the accident) about half-past seven o'clock. At that time, as far as I could discover, every thing was safe, and the currents of air in the pit free and good. The Bensham seam of Wallsend, particularly at the brokens, contains a great quantity of gas, but is safe to work at with Davy-lamps. On the Thursday morning the workings were in a particularly good state, and perfectly safe when I left it. Shortly before the blast took place, which was about half-past two P. M., all the hewers had come up except six; the number that had thus left the pit might be about 88. These six men had, shortly before the others ascended, gone in to their work. The six men were working at the whole coal, two of them at the north-west district of the mine, and the other four about 200 yards from them, but in the same district. These men were working with candles, the mine there being sufficiently well ventilated to admit of it with safety. The rolly-way they went up from the G pit, when they descended, proceeds in a direct line near to the quarter where they had to work. This rolly-way may always be travelled with candles. At the face of the boards where these men were working, the gas sometimes fires at the candle when they are drilling holes to blast the coal; but it fires in so small a quantity at these holes that it is easily dowsed out with their jackets; but if the gas was not soon extinguished it would not spread or communicate with any other place. As far as I have been able to explore, near the place where

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these men were working, there are no appearances to cause a belief that the pit had first fired there. The same morning I was at the place where the men were working the broken in the fourth south district of the C pit. I found all safe there; these men were working with Davy-lamps, and the pit in that part was considered quite safe. The thickness of the band-stone at the broken at this place is between eight and nine inches. The pitmen have to separate the stone from the coal, and are not permitted to allow any of the stone to mix with the coals that are sent to bank; if there is any quantity of stone found amongst the coal the pitman is fined from 6*d.* to 2*s.* 6*d.*; but if an extra quantity, the corf of coals is forfeited altogether. The Davy-lamp shows sufficient light to enable the pitmen to select the stone from the coal, but of course they cannot do it very expeditiously. I never to my knowledge, since I came to Wallsend, knew the workmen take the top off the Davy-lamp to procure more light, but have known the Davy top taken off for that and other purposes, for instance to light their pipes, at other collieries. When such an occurrence as this has come to the knowledge of the viewer the men have been invariably discharged. On Thursday morning last I, in company with the wasteman, travelled the gas drift from near the broken at the north-east part of the mine, west of the G pit shaft; it was about three o'clock in the morning; we found the air in the drift in a good state, it would not fire at the lamps. Has known it frequently fire in the drift at the C pit. They left the drift at the doors near to the G shaft; they were closed and secured after they passed through, and locked. I have known the staples drawn and locks taken off the doors. This has occurred thrice since I came to Wallsend. Have known three taken off in one week; the last occurrence of the kind that came to my knowledge was six or seven months ago. From these doors being thrown open the pit in that part becomes dangerous, but no bad result fortunately has happened. I have frequently known the pitmen smoke in the whole boards, it is considered there is no danger by doing so in those parts; but it would be highly dangerous for them to smoke in the broken quarters, and no one is allowed to do so on pain of being discharged. I have not heard any of the men say that the mine was unsafe to work in; the Davy-lamp fired at the broken the day before the accident, but there was nothing of consequence in this as it is of frequent occurrence. The depth of the pit from the surface to the Bensham seam is about 146 fathoms. The thickness of the Bensham seam varies from five feet to six feet. There is a band of stone of variable thickness in this coal, from four inches to twenty inches in parts. This band is included in the thickness of the seam. Cannot tell what quantity of gunpowder is used by the men in each blasting. They blast both below and above the band, but the shot is put in near the roof above and near the bottom below. The blast does not render the roof or pavement unsafe.

John Atkinson.

John Atkinson the younger, son to the last witness, sworn, says: I am overman at Wallsend colliery, and have been employed there upwards of three years; my duty in the colliery is to go down the pit daily and see that everything is right. If there should be any part in particular which I do not judge necessary to examine, I get the report from my deputies. There are deputies in the pit constantly during the time of its working. The deputies consist of seven, namely, five deputies, and first and second deputy overman. On the day the misfortune happened I went down the pit a little after two in the morning, and found everything right, and in some parts the air was better than usual; that is, there was a less discharge of gas this morning particularly than the morning before. I was not through all the workings, only through three districts out of the four. The reason of my not going through one of the districts was that my father and one of the wastemen were there before me. My first visit in the morning was to the second north-east district, where the men were to begin to work the broken. The hewers would commence about three o'clock, and the number to be employed there might be about 18. My object in being there before the workmen was to ascertain if there was any superabundant discharge of gas, as an extra discharge had taken place the previous day. I found the pillar where the men were to work entirely free from gas. The Davy-lamps are suspended or placed near to the face of the coal where the hewers are working, each man has a Davy. When the gas in the interior of the Davy-lamps becomes highly inflamed it is prudent to withdraw the men. When the Davy-lamp becomes in a red-hot state it is probable, if continued near the board, an explosion might be the consequence, but I never knew an instance of it. When the props are withdrawn at the broken to let down the stone (the coal having been taken away) a discharge of gas generally takes place; at this time the men retire with the lamp a considerable distance from the quarter, and do not return till the place is quite clear of gas; if the gas continues in any quantity they are withdrawn altogether. The broken quarter before alluded to contains an immense quantity of gas, and, as has been before described, is a complete gasometer, and if not for the judicious system that has been adopted in carrying a fresh current of air round the skirt of the goaf, it would be totally unapproachable. There are various main doors in the course of this current of fresh air, which, if negligently left open or accidentally injured, the current of fresh air would be prevented from going to the parts where it is required, and the consequence be the workings there filled with noxious gas, so as to render the place dangerous and unfit to work in. These main doors are substitutes for stoppings; stoppings being built up permanently with brick, but at these places two trap doors are hung, so that if one of them is injured or displaced the other would be a protection. I have known one of the doors accidentally injured, and sometimes negligently left open. The deputies and myself have an opportunity of seeing these doors frequently through the day, so that if anything is found wrong it can be replaced.

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replaced. The main doors above described are for the purpose of ventilating a large portion of the mine, and the trap doors are used for admitting fresh air to the boards, where two men are placed at work; each board has a trap door. The main doors have, on all occasions, either an old man or boy stationed at each for the purpose of opening and closing them. The trap doors are left open until the hewers in the board proceed to such a distance as to require a greater supply of fresh air; the trap doors are then closed, by which a circulation takes place to the face of the board, and then a boy is stationed at the door to keep it closed and open it when required. I have known instances of the trappers having left their station at the doors, but they have not been absent for any length of time, so that if any accident or inconvenience took place from it on those occasions the delinquents are punished, and if it was frequently to occur they would be discharged altogether. The men who are thus employed are old and infirm, being past doing any hard work, but are quite competent to that duty. The boys vary in age from seven to 14. From my experience, I can put more dependence upon the old men engaged in this employment. The younger boys are placed at the least dangerous places; the old men and elder boys are placed in situations where more care and attention are required. The old men have 1 *s.* 4 *d.* per day, and the boys from 10 *d.* to 1 *s.* 2 *d.*; at the present time, according to the best of my recollection, the men and elder boys average about ten days' work in the fortnight. If it was not for the greatest care and attention in obtaining a sufficient current of atmospheric or fresh air, and throwing it through the workings of the Bensham seam, the pit would be altogether unworkable. On the morning of the misfortune, a little before four o'clock, and after the men had commenced working at the broken, I looked into the dumb drift near to the broken; I did not find there such a quantity of gas as to render the air inflammable with the Davy-lamp. At the place where I entered the dumb drift it was with the return of the air where there are no doors, and where the state of the broken can be best discovered. I found the air so good where I entered as assured me all the doors were secure, I mean the doors entering into the dumb drift, which are kept locked. The old workings at the south-west of the G shaft are continually charged with vast quantities of gas, which is carried off by the dumb drift, and is discharged through the dumb furnace up the B pit shaft; therefore, as long as the dumb drift is kept in proper order, this gas cannot escape into the workings. After satisfying myself with the safety of the workings at the broken at the second north-east district, and waiting to see the boys set to work at their proper stations, I proceeded to the second north-west district, where the men were working the whole and broken coal; these men were divided into two districts, there were eight men at the whole coal, and from 14 to 16 men at the broken: the whole and broken quarters may be about 150 yards separate from each other. These two quarters are ventilated from the C pit. I found the air at the broken perfectly good; from this broken a great quantity of gas is discharged, but when the men were working the gas is driven away from them by a good current of air, and escapes into the C pit gas drift. The same observations apply to this quarter as to trap doors and air courses, as relates to the former broken described. Between this broken quarter and the whole quarter, where the eight men before mentioned were at work, there is no communication except by the way the coals are taken out, and if any communication took place between these two parties of men the nearest road they could go would be near 200 yards. The eight men described as working at the whole coal in this district were stationed two men in each board; the boards are 20 yards separate from each other. At these boards the men work with candles. The candles are lighted at the G shaft when they enter the pit, and carried to the place of employment. In proceeding to their work with their lighted candles they proceed so far up by the side of the gas drift, but not nearer than 20 yards of it; and if the men go the direct way from the G pit to their work at the whole coal above mentioned, they cannot possibly come in contact with any current of gas so as to render it dangerous with candles. At this whole coal quarter the coal is thrown down by blasting with gunpowder; the band in the coal is previously taken away to make room for blasting the coal. They drill holes into the coal from three to four feet to put the charge of powder in; from these holes gas occasionally escapes, but not in a sufficient quantity to render it dangerous from coming in contact with the candles. At the place where these eight men were employed there is no gas whatever. I have known, since I came to the colliery, explosions taking place in the Bensham seam occasioned by working with candles, through the negligence of the workmen or boys. Men have been burnt but no lives lost. I have occasionally known the gas explode at the gunpowder when it was discharged, but no accident from it. Smoking is not allowed in the broken quarter, and, to my knowledge, a lighted pipe is never taken there; but in the whole quarter there is no objection to it. I have heard of a pipe being lighted at the Davy-lamp, but not at this colliery. I have also heard of the top of the Davy-lamp being taken off to obtain more light in the broken, but not in this colliery. When I examine the workings I go with a candle in the whole quarter, and a Davy-lamp in the broken one. It is my daily business to examine the different currents of air, both at the commencement and leaving of the workings, and previous to this misfortune I found all the currents of air in a safe and workable state. There are open oil lamps placed at different stations; the nearest to the broken quarter where any of those are stationed may be about 140 yards. The state of the atmosphere above ground has a materiale ffect on the gas and air in the pit. According to the density of the atmosphere above there is a greater or less quantity of gas emitted from the seam; and for the like cause the current of air carried through the workings is also defective and not so good. On this state of the atmosphere I do not think, according to my experience and belief, there would such a

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quantity of gas escape from the broken as to reach the place where the oil lamp is stationed. On the morning of the 18th, the day the misfortune happened, there might be about 90 hewers (including four who went down about nine o'clock) in the pit between two and three o'clock; the deputies had been down previously to the men, and had visited each board to see that it was safe. Others had been at the broken for the same purpose. The whole of these 90 men (except six) had left the pit at about nine, as they had finished their work till the misfortune happened. The men and boys who were lost went down the pit about half-past four in the morning. None of the men made any complaints that the pit was in a bad state; not one. No part of the workings had holed into any old waste. As far as I have been yet able to explore, I have found no appearance to denote where the explosion originated.

John Atkinson, jun.

John Moor, Shiney Row, deputy overman at Wallsend colliery, being sworn, saith: I have been 27 years employed down the pit at Wallsend colliery. My duty is to go down the pit before the men descend to work, to examine and see that all is safe and right as far as my rounds extend. On the morning of the 18th, I went down as usual, and found the workings as free from gas as at any former period. There was nothing in the state of the weather that morning when I went down, to cause my particular attention. I first visited the first west crane in the whole quarter; I then went to all the boards in that quarter. I afterwards proceeded to the broken, at the east crane; having got to this point, my duty for this day ceased. I left the pit about half-past nine. Before I left the pit, and after I had completed my rounds, I reported to the man who next succeeded me, that I found nothing strange in the pit. Within a very short time after the alarm was given of the explosion, I was down the C pit to render what assistance was in my power, but I could not safely proceed more than 400 yards, on account of the after-damp. All the doors and stoppings in these 400 yards were blown down. I have not been in the workings since that day.

his
John + *Moor.*
mark.

Edward Combie, Wallsend, sworn: I am deputy-overman at Wallsend colliery. I have been employed about 15 or 16 months in that capacity. My duty is to go down the pit in the mornings, before the men descend to their work, to examine and see all things are correct, and to prepare timber to secure the roof. I went down at half-past one o'clock, on the morning of the 18th, and found the pit in a regular, safe, workable state. I first proceeded to the far-west part of the workings, from thence to the far-east part of the workings, and at that point my work ceased. I returned to bank at eight o'clock in the morning. During my morning's work I found occasion to set timber to secure the roof at the broken, both at the east and west parts of the mine. Since the misfortune happened, I have not been further in the workings than 60 yards from the shaft. None of the men made any complaint that the pit was in a bad state. I and the last witness are the only deputies remaining; the three other deputies and one overman have been lost.

Edward Combie.

John Bell, Wallsend, hewer, sworn, saith: I have wrought in Wallsend colliery 19 years gone April. Was last down on the 18th of June, the day the misfortune happened; I went down a quarter past two o'clock in the morning of that day, and returned to bank a little before 11 in the forenoon. I was working at the broken at the east part of the colliery. When I went to work in the morning, I did not find the pit at the broken so bad as I did the day before. I used a Davy-lamp. There were other five men working at the same place with me, who all had Davy-lamps. The day before the misfortune took place, the pit was in so dangerous a state that we were obliged to come away. We extinguished our Davy-lamps before leaving, except one man who reduced his light as small as possible, so as to give us light to find our clothes before leaving. Edward Combie had previously left us to go to some other men on the other side of the mother-gate, to warn them away. There are separation doors between the foul air and the fresh; one of these doors may be about 60 yards from the headway where we go in to work; the other door is about 20 yards further on; the entire distance from the place we were working to the outer door, may be about 136 yards. There is placed about two yards and a half from the outer door, an oil lamp. I considered this lamp to be too near the separation doors, and desired one of the boys who keeps the lamps (he is lost,) to shift it further out by, as I was apprehensive that if any fall took place where we were working (which is an usual occurrence,) that the foul air would be forced with such violence against the separation doors as to force through them and explode at the lamp. These doors were quite in order, except that they did not sufficiently fall to. Since I went into that part to work, I never considered the door next the broken to have a sufficient fall, according to my judgment. I was never afraid till the 17th, when a fall occurred. I never mentioned to any of the overmen that I had apprehensions of the unsafety of that door, or that the lamp was too near the door. On the 18th, when I went to work, the lamp that I complained of to the boy the day before, was still there; it was not burning when I went to work, but on returning I found it burning, and on passing the boy who had charge of it, I again repeated that the lamp ought to be removed further off. I have

not

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not been down since the explosion, but from what I have heard I have reason to believe the pit did not fire at that place. I saw the overman, John Atkinson, junior, at the place where I was working on the morning of the 17th, having sent for him in consequence of apprehension of the stone coming down. The roof then bearing heavily upon the props, had caused the bottom or pavement to lift, and a quantity of gas was escaping from it; the gas that came away was so overpowering, that we had to extinguish our Davys as before mentioned. On the overman arriving, I pointed out to him the situation of the stone, and he said, if she came heavier on the props, meaning that the stone was likely to fall, they were to take up the plates. About four or five hours after this, the stone did fall, and the consequence was, the gas was forced out a great distance from the broken; the Davy-lamps then became red-hot, and were extinguished as soon as possible, except the lamp before named, the flame of which was reduced, and they left immediately. Combie, the deputy, was present when the stone fell, and left, as before mentioned, to send the other men away. The men who were working with me on the 17th were, Charles Swan and Matthew Buddle on the west side, and on the east side Thomas Rotherford, Thomas Wilkinson, and Jacob Maddison. On the succeeding day this particular place was in a much more workable state, otherwise we could not have gone in. There was only a partial fall of stone, which did not prevent the men continuing their work. They left their work a quarter before 11 o'clock in the forenoon, but I cannot say the pit was then in a safe state for working. This was mentioned amongst the men, and to Joseph Lawson, who was a deputy, and a very cautious man. I warned him to be cautious. We left work on the 18th, not on account of the danger, but that our shift was finished; at the same time I considered the pit was not safe at our place. All the six Davys were on fire this day. (John Bell's and Matthew Buddle's lamps produced; they appear to have been subjected to an intense heat, but no ways injured, or rendered unfit for use.) Since I came to work at the C pit, Wallsend, two men, William Lenox and Andrew Brack, have been burnt by the gas. In the boards where they work with the candle partial explosions of gas have taken place, and I have myself been present when it has fired.

John Bell.

Thomas Rutherford, lives at Wallsend, hewer, sworn, saith: I have worked at Wallsend colliery for about 20 years; was working near to where the last witness was on the 17th and 18th June; can corroborate what John Bell says happened on the 17th; I have heard the evidence he has given, and as confined to what happened on the 17th, it is correct. On the 18th, I went down about two o'clock in the morning, and found things better than I expected; the pit was in a more workable state than it was the day before; in consequence of the fall that had taken place the previous day the foulness had subsided. There was a trifling fall on the 18th, but it was at some distance from me; these falls frequently take place at the old goaves, and are not much minded. Where I was working I found myself very warm all the day, but I did not notice anything particular about the lamp. I was working about 20 yards from the place John Bell was; in the range of our working we may occasionally approach within six or eight yards of each other, and can hear each other talk, and when we are so near, could if we looked from our work see each other. Bell and his companions finished their work before I did, and Buddle came to me before he had done his work, and said his lamp had fired. I stopped and finished my work, and when I left I told the boy to be careful in filling the coals; my companion and myself left our work a little before 12 at noon; the boy would have had to remain about five hours after they left, to put the coals away; Bell and his companions might leave their work about an hour and a half before him. There are several boys always left behind the hewers, to put the coals after the hewers' work is done. The boys are all furnished with Davy-lamps for lights. The boys are superintended in their work by the deputy and back overmen; these overmen are not stationary at one place, but go about the pit, and continue there till the boys have finished taking the coals away. When the Davy-lamps first came into use, I have known an instance of the top being taken off by a boy, but have not heard anything of the kind for several years. The Davy-lamps when first used were not constructed with a lock, but those I have seen lately have all locks. I understood the explosion took place a little before two in the afternoon; the pit was not in a worse state when I left, than it was when I went in the morning. I never found the pit in so bad a state as it was after the fall on the 17th; Thomas Wilkinson and Jacob Maddison were working with me.

his
Thos. + *Rutherford.*
mark.

Charles Swan, Wallsend, hewer, sworn: I have worked 14 years at Wallsend colliery; have worked four years in the Bensham seam; always considered it a dangerous seam, from the great quantity of foul air that exists in it. Several small explosions often take place, but they are not considered dangerous. On the 18th June, I was working at the broken, on the east side of the colliery, with John Bell, Matthew Buddle, and Thomas Rutherford, we went down to work about two o'clock in the morning; when I first commenced work, I placed my Davy-lamp near the roof, and she immediately fired; I then took the lamp down, and cautioned the men to be careful with theirs. After I had worked for an hour, I put my Davy-lamp up again near the same place, and she fired again;

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I took it down, and while fixing it against the prop, it fell and went out; I sent it away with one of the putters to be relighted, but not till it had been examined by the boy who had the charge of the lamps; three or four Davys were sent in lighted before I got my own; I continued to work with them till I was done. When I left my work I did not consider the pit safe there; the foul air was coming off the goaves at the north side of them; we left about half-past ten o'clock in the forenoon. No fall had taken place to my recollection that day, at the place I was working. I met Simpson, the back overman, as I was leaving, I told him to caution the boys to be careful. I was working at the same place on the 17th, the previous day; the time I was there then was short, and I did not discover more danger than usual; I was in the jud where John Bell and his party were working for a short time, and found the place in a dangerous state; this was before the fall; the men were afraid to go in to work till the deputy came, who renewed some of the timber; I had done my work, and soon left them. James Hepple, the young man who was in the chief charge of the Davy-lamps, had not come near them either on the 17th or 18th, or been there for a week before. The boy under Hepple, called Thomas Elrington, who has charge of the lamps, may be about 13 years of age; neither he or Hepple came when his Davy-lamp went out; but they sent him fresh ones in the course of five minutes. I saw the overman at the place where I was working on the 18th; I saw the same overman, John Atkinson, jun., on the 17th, when he was sent for by Bell. As far as I could judge, all the doors were right; but at best, with all the care that can be taken, I consider the Bensham seam is very dangerous to work in. The men have no higher wages for working in these dangerous places. There is a band of stone runs through the broken the same as the whole; the stone is taken out altogether before the coal is touched, if there is not room for it; the stone is sent away by the boys to other parts of the old workings. If any stone is mixed with the coal, the pitmen are fined. The tops of the lamps are never taken off for a better light, to enable them to separate the stone from the coal.

Charles Swan.

George Jude, Wallsend, hewer, sworn, saith: That I have been employed at Wallsend colliery 27 years. The last five days previously to the misfortune, I have been working at the whole coal, in the second north-west district; Robert Bell was working with me at the same board; we worked with candles; the pit was well ventilated at the place where we were working; there was no gas that we perceived at our place; there was no fire when we blasted the coal; there are no old wastes near to where we were working; I always considered the Bensham seam generally to be a dangerous one, but at the place where I worked it was not so; there was always good air from the C pit. The explosion that took place and destroyed 52 men, 14 years ago, was in the Bensham seam; since that period, believes the workings have in general been better ventilated.

George Jude.

Alexander Haxton, lives at the Low Moor End: I am a wasteman, and have been employed at Wallsend colliery 23 years. My duty is to keep the air-ways good, and am constantly down the pit seven hours a day. I consider the Bensham seam to be a foul, dangerous pit, more so than any in this neighbourhood, and it requires the utmost caution and attention to keep her in a workable state. On the 18th of June, my master, Mr. John Atkinson, senior, and myself, travelled all round the wastes, and the air appeared to be as good as at any time I recollect. We went down the pit that day before two o'clock in the morning, and were down about six hours, coming up at eight o'clock in the forenoon. We passed the men at the different board ends, and the work was going on as usual. We found all the main doors correct that day. I have heard the men who were working at the north-west quarter near the C pit, say, that their Davys were rather fiery; one day when I was there, I observed the flame rise up on the Davy, which was occasioned by the gas, but it soon subsided again; I told the men I would shift them to another place if they liked; but the flame so soon subsiding to its usual state, they continued. I was through the dumb-drift on the 18th, in the morning, and found the air there as good as usual. Since the misfortune happened, I have been over all the workings of the pit as far as they could be explored, but have not yet discovered any appearance to lead to or conjecture where the explosion commenced. I have got no further than the crane at the far end of the pit. The places which I have visited, especially the first west-north district, there has much damage been done; the doors, traps, and stoppings have been blown away, and also much damage has occurred at the far west district. We have not yet been able to get into the dumb-drifts.

his
Alex. + *Haxton.*
mark.

George Watkin, lives at Wallsend colliery; is a hewer; sworn; saith: I am 26 years of age, and have worked in the Wallsend pit all my life; I have worked in the Bensham seam seven years, and have been working at the whole coal for the last six months. The Bensham seam is considered dangerous to work in, but not where I was employed, which was at the first west crane quarter, near the C pit. That on the 18th June, and previous days, we had too much air; it sweeled the candles, so much so, that I asked the deputies to take the brattice down to lessen the current of air. I have, in the absence of the overmen, taken the brattice down myself, and have not been found fault with for so doing.

George Watkin.

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James Hepple, Wallsend, sworn; says: that I have the care of the Davy-lamps; I have never observed the lamps to have sustained any damage by the apertures having been widened, or otherwise; recollects the place where Charles Swan was working; it was the broken, at the east crane; it was no part of my duty to visit the place where he worked; the two boys who are under me attend to this place; and when the lamps go out they take them away, retrim, light, and send them back.

James Hepple.

Jacob Maddison, Wallsend-Moor, says: I am a hewer, and have worked for several years in the Bensham seam, Wallsend. Generally speaking, the Bensham seam is more dangerous than the main seam. On the 17th June there was a fall where I was working, and a great quantity of foul air came away; my lamp fired on the 17th, and so did the whole of the lamps of those who were working at that place. The foul air drove us back to the narrow board: when this happened we were obliged to leave work as soon as we could, for we considered at that time the jud to be in a very dangerous state by the fall. On the 18th, the following day, when I returned to work near to the same place I found the new jud, which was about nine yards off the jud we had worked at the day before, in a very workable state; I continued to work there the whole day, and nothing occurred to annoy me. My lamp did not fire that day. I returned from work about half-past 11 o'clock in the forenoon, and was at the bank by 12; Charles Swan was working about 12 yards from me; and Bell close to me. I have once or twice before seen the Bensham seam in as bad a state as it was on the 17th, occasioned by a fall, and have once before seen the lamp fire.

Jacob Maddison.

John Dawson, Swan's Row, Wallsend, sworn; says: I am hewer, and have been employed at Wallsend colliery for 30 years and more; I have worked in the Bensham seam several years; I have always considered it to be a very dangerous seam; have known explosions of gas to take place in the Bensham seam, but no person hurt, except on this occasion, and when the accident happened 14 years ago. I have been twice in the broken and twice in the whole this quarter. I have known the gas take fire in the east narrow boards where the broken is now worked, and the men have had recourse to wet cloths to extinguish it, when I wrought in the east juds, where Bell and the other men have been working. When I first went into the east juds to work I have seen the lamps on fire, and in that state have considered it unfit they should be continued there. I went out for the deputy, and told him, and he instantly took a trapper to put on a door, which admitted more fresh air, and thereby made it safer to work. I have known when falls took place a deal of foul air come off; and I considered it required great caution to work at this quarter.

His Mark
John + Dawson.
and Seal.

Robert Giles, Wallsend, hewer, sworn; saith: I was working in the Bensham seam on the 18th June, at the broken, in the west and north quarter; I could find no fault while I was there, the air appeared to be as good as usual; there was no fall while I was there; I left the pit about ten o'clock in the forenoon; my lamp did not fire that morning; I have only been 12 days working in that quarter; my lamp never did at any time fire while working in that quarter; I never heard of any of the other men's lamps firing in that quarter.

His
Robert + Giles.
Mark.

Robert Usher, Wallsend, hewer, sworn; saith: I have worked in the Bensham seam for these 14 years past. On the 18th June I was working in the west district. I felt no difference in the ventilation; the air appeared just as usual. There was no fall where I worked; my lamp did not fire. For two months past I have been working at that place, and my lamp did not fire at any time; can form no idea where the pit fired.

His
Robert + Usher.
Mark.

John Atkinson, the elder, re-examined. The furnaces for ventilating are about 23 yards from the shaft bottom at the A and B pits. The gas is conveyed up the shaft about four fathoms above the furnace; it cannot come in contact with the flame; I have never known the gas to fire at the furnace in the B pit of Wallsend colliery. Two years and a half since a man was killed by an explosion of gas at the C pit; it was at the furnace where it happened, and the gas in all probability fired there. This furnace has not been altered; it has not been burning since that time. A new furnace was built at the B pit, and it was shifted further back than where the old one stood, as a matter of precaution, and to be further out of the way of the gas. We have been employed in heightening the drift from the G pit in a line with the A pit, at about 460 yards from the G pit; the dumb-drift was about 20 yards from the drift they were engaged in heightening, and runs nearly parallel with the dumb-drift; there were two men found at or near to the place where they were heightening the drift, who had been employed in doing so; there was no

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oil-lamp nearer that place than 140 yards; the men had candles who were working in the stone drift; the stones that came down in heightening the roof were stowed away in a double headway, about 40 yards from the place the men were working at; the men used gunpowder to blast the stone from the roof of the rolly-way; there was a main door and a trainway main door; one door would be about 15 yards from the place where the men were blasting with powder, and the other door about ten yards further on; the nearest of those doors would be about 70 yards off the old workings, or waste, which are filled with gas; and, as Mr. Buddle describes, as being complete gasometers. In firing the blast or shot it is not likely that those doors would be thrown open by the concussion; but if those doors were left open, there would be danger from the blasting. I cannot say whether those doors were open or shut; I saw the men working at the rolly-way on the Tuesday before the misfortune, two days before; I did not consider the work they were engaged in dangerous, but I cautioned them about the doors; I have been as far as where the men who were working at the drift were found, but could get no farther for the after-damp; one of these men was found much burnt, but I did not see any marks of fire near the place. If the explosion originated at this place, there would not be any marks of it where the men were found, but in all probability some marks may be discovered in the dumb-drift 20 yards off; have not been able to explore the dumb-drift since; the man that was found burnt was severely so; the men might be about two yards apart from each other; they were found about 40 yards from the place where they were, or ought to have been, working; the explosion has blown the stoppings out east of the place where the work at the rolly-way was going on; the stoppings are made of brick, and nine inches thick; they are calculated to afford considerable resistance; all the stoppings in and around that particular place have either been wholly or partially thrown down; the doors above described, between the rolly-way of dumb or gas drift, were not locked; to the best of my belief there was a sneck or latch upon them. Through these doors, into the gas or dumb-drift, I consider it to be very dangerous, there being vast quantities of gas in the old workings in that vicinity. When travelling this district with my Davy I have never seen any fire there, but in the adjoining district I have known it to fire frequently; in this district, the first south-west, the gas is constantly feeding into the dumb-drift, and the gas is also constantly feeding into the dumb-drift from the second south-west district, so as to render these places near where the men were working at the rolly-way before described, exceedingly dangerous. The men were found about 15 yards from the doors above-described; I do not know that they deposited their tools within these doors, but I know they had orders not to go near the doors; for I gave the order myself. I consider it would be dangerous if those doors had been left open. It is possible, if those doors were open, the gas might fire at the candles the men had with them, where they were working at the rolly-way. Robert Moralee, one of the men who has been saved, was keeping a trap-door, about 60 yards west of the shaft of the G pit. The place where the two men above-mentioned were working at the rolly-way is from 330 to 350 yards to the west of where Moralee was tending the trap-door. This man Moralee, who is unable to attend and give evidence in court, described to the Reverend John Armstrong and Mr. Anthony Easterby, two of the jurors, that the first sensation he experienced, at the time this accident or explosion must have taken place, was a ringing in his ears; and then he heard what he described a booming noise proceeding from the west, and immediately he felt the door he was tending thrown against him. At this time he was standing at the east side of the door, he was deprived of sensation, and when he recovered, he found what he thought to be the door lying upon him. The above jurymen further examined John Middleton, the little boy who was saved, and who is too ill to attend in court, being very severely burnt. This boy was a rolly-driver, and describes himself as having been employed in the west rolly-way; and the first indication he had of something having gone wrong, was a noise at the trap-doors to the west. This boy's account appears to coincide with Moralee's, but he is exceedingly ill, and unable to undergo examination.

John Atkinson.

John Atkinson, jun. re-examined, saith: I was in the workings in both quarters, the second north-east district, and the second north-west district, on the morning of the 18th of June, when the accident happened. There were two men working at the rolly-way, increasing the height of it to admit of horses, which rolly-ways are generally made about six feet four inches in height. I saw these men engaged in their work about a week or 10 days before the accident, but it is out of my district, and I did not see them the day I was last down; my father had generally taken these men under his charge.

John Atkinson, jun.

Alexander Haxton, re-examined: I was down in the workings of the Bensham seam at half-past eight o'clock on the morning of the 18th of June. Near where the two men were working at the rolly-way, there were two doors leading into the dumb or gas drift. I saw those doors on the 17th. The morning before the accident I went through the doors into the dumb-drift, to examine the course of the air; these doors were not locked; they were never locked. I have known the men who were working at the rolly-way deposit their working gear between the doors of the first south-west district (which, as has before been described by Mr. Atkinson, sen., is the most dangerous place in the Bensham seam), I have seen the men twice put their gear there; the last time I knew of it is six months ago. I told them to put no more gear there, which they promised not to do. I put a lock

on

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on the doors. I was through these doors on the 18th of June; I found them locked, and left them so after passing through. The reason of those two doors near to the place where the men were working at the rolly-way, not having been locked was, that they were considered so far out of the way, both of the boys and men, that there was no occasion for keeping them locked. I cannot say that these men left their gear between these two doors last spoken of, but I think it looks very like it; it has the appearance of it. Had I found the men leaving their gear at this place, I would have had them up before Mr. Buddle. I should have considered it so extremely dangerous, and consequently wrong of the men to do so.

His
Alexander + Haxton.
mark.

Thomas Kennedy, Wallsend, furnace-keeper, sworn, saith: I have been employed nearly 40 years at this colliery. My duty is to attend the furnace at the B pit. This furnace is at the bottom of the shaft. When I went to work on the 18th of June I went down the G pit; from the bottom of this shaft to the place where my duty was at the furnace might be about three-quarters of a mile. I went along the drift which proceeds westward from the G pit to the furnace. On my road I passed the place where two men were working at the roof of the drift, increasing the height of it to admit of a horse travelling along. These men were lighted at their work by candles. I never saw any men at this place with pipes. At the time that the explosion took place, I was convinced something wrong had happened from the current of air that was forced to the place I was at. After remaining about a quarter of an hour I found it prudent to leave the pit, but could not return the same way I had come; I therefore persuaded the man who was with me to try the C pit, which was to the north of us. We found very great difficulty in getting to the C pit, but ultimately succeeded in making our escape.

His
Thomas + Kennedy.
mark.

John Pattison, Wallsend, banksman, sworn, saith: I have been employed above 40 years as banksman at the Wallsend colliery. My station was at the G pit. On Thursday the 18th of June, about two o'clock in the afternoon, as I was landing the undermost corf of coals that had been drawn up, the empty corf having been thrown into the shaft again, and before we got the middle corf which was suspended above the mouth of the pit; the blast came up the shaft (to explain this, there are three covers brought up by the chain together, one above the other). The violence of the blast blew the empty corf out of the shaft to bank again, it also took my hat off and threw it over the pully, which may be 26 feet from the ground. The shaft was closed up with rubbish, so that all access to the pit down the shaft was closed up. When I turned round a few minutes afterwards I looked at the C pit, near Wallsend village. I saw the smoke coming out of it. No other men were saved at the time of the explosion but the two furnace men, who got out at the C pit. Afterwards three men and one boy were got out alive.

John Pattison.

James Mac Intire, of Newcastle-upon-Tyne, surgeon, sworn, saith: I attend the Wallsend colliery. Have seen several of the bodies since they were brought from the pit. Some of them were very severely scorched by fire, others had no marks upon them, but had died of suffocation by inhaling the carbonic acid gas. Others I understand (but whom I did not see) had their bodies much mutilated. Three men and a boy were got out on Saturday, the 20th June, from the pit alive; all are likely to recover. One man has undergone amputation of the leg above the knee; but all are unable to be removed to give evidence; it cannot be done with safety to them. Brown and Morallee are competent to give evidence but unfit to be brought into court.

James Mac Intire.

The above examinations were duly severally taken, on the 22d, 23d, 25th, and 29th days of June, at the place first above-mentioned, to wit, at the School-house at Wallsend, before me,

S. Reed, Coroner.

(COPY INQUISITION.)

Northumberland } An inquisition indented, taken for our Sovereign Lord the King, at
to wit. } Wallsend, in the parish of Wallsend, in the county of Northumberland, the 22d day of June, in the fifth year of the reign of our Sovereign Lord, William the Fourth, by the grace of God of the United Kingdom of Great Britain and Ireland King, Defender of the Faith, and in the year of our Lord 1835, before Stephen Reed, esquire, one of the coroners of our said Lord the King, for the said county, on view of the body of John Giles, then and there lying dead, on the oaths of Anthony Easterley, John Wright, John Armstrong, Patrick Rye, William Jameson, Robert Henry Coward, Matthew Elliot, Joseph Mordue, John Hornsley, John Brough, George Shanks, John Falcus, Charles Weatherly, and Washington Potts, good and lawful men of the said county, duly chosen; and who being then and there duly sworn, and charged to enquire for our said Lord the King, when, where, how, and after what manner, the said John Giles came to his death, do, upon their oaths, say, that the said John Giles, on the 18th day of June, in the year aforesaid, at the parish and in the county aforesaid, being at work in a

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certain pit or coal-mine, called the G pit of Wallsend colliery, it so happened that the inflammable air, accumulated and contained in the workings of the said pit, from some cause or causes, and in some part or parts thereof, to the jury unknown, ignited and exploded, by reason and means whereof he, the said John Giles, then and there accidentally, casually, and by misfortune, received divers wounds and contusions in and upon his body, or otherwise was burnt and suffocated, and thereby presently died. And so the jurors aforesaid, upon their oaths aforesaid, do say that the said John Giles, by reason and means aforesaid, and in manner aforesaid, accidentally, casually, and by misfortune came to his death, and not otherwise. And that in the opinion of the said jurors there has been no want of due care and precaution on the part of those who have had the direction and management of the said mine. In witness whereof, as well the said coroner as the jurors aforesaid, have hereunto set their hands and seals, the day and year first above written.

Mr. *George Mitcheson,* called in, and Examined.

Mr. *G. Mitcheson.*

2511. WHERE is your residence?—Lane End, in the Staffordshire Potteries.

2512. What is your present engagement or profession?—Mine agent.

2513. Does your profession bring you acquainted with the mines in the Pottery districts?—Yes.

2514. At what depth is the coal found in the principal of those mines?—At various depths, from 50 to 300 yards, and upwards, and there has been a mine explored at the depth of more than 400 yards.

2515. Is there a succession of seams?—Yes.

2516. Will you name those seams as they are generally found?—I cannot name them particularly now, but I could give a section.

2517. Are they numerous?—Very.

2518. What is the thickness of the bed, at the greatest and the least, which is wrought in your neighbourhood?—The thickest that I know that works in our neighbourhood is about 9 feet, and we have occasionally worked some at 20 inches, but that is very partially done; none are much worked under a yard or four feet.

2519. Are you a native of that part of the country?—No; I came from the north of England.

2520. How long have you been resident in Staffordshire?—About seven years and a half.

2521. You are acquainted with the mines in the north?—Yes.

2522. Are those mines in Staffordshire what you would have called in your own country, dirty seams?—Very few of them.

2523. Can you draw any comparison between the seams you are at present conversant with, and any of the well-known seams on the banks of the Tyne and Wear?—I know one seam or two that we are working that has as large a portion of gas in them as the Tyne main coal has in some districts on the banks of the Tyne.

2524. What coal is that?—The Ash and the Great Row mines.

2525. Are you alluding to the Tyne main colliery prior to its being last opened out by Messrs. Lorish?—I allude to the Tyne main seam coal; I do not mean to say that there is as large a portion of gas in the seams alluded to in Staffordshire as there is in the Tyne main colliery, as in some collieries, but I mean to say that there is as large a portion of gases in the mines alluded to in Staffordshire as in some parts of the Tyne main coal.

2526. Does the effusion of gas place the working men in any of your collieries under circumstances of personal risk?—Yes; frequently.

2527. Have any explosions taken place since you were upon the spot?—Yes; but not to cause blasts, as Mr. Buddle terms them, but what he would call explosions of fire, when from one to two men have been lost at a time; not at any one time more.

2528. Have you any document or memorandum which would enable you to lay before this Committee an account of the number of fatal accidents which have occurred during your residence in that district, at your own colliery, or any collieries generally?—I have no document or memorandum, but I could tell within a trifle the number.

2529. Will you state the number of men and boys who have perished in your mines from explosion in the period of seven years or upwards, to which you have alluded?—To the best of my remembrance, about eight by fire in my colliery.

2530. Have you any impression of the number that have perished from other accidents connected with mining in the same period?—I should think six or seven more have lost their lives by other causes.

2531. Out of what numerical proportion would you consider that number to be taken as employed in the mines?—About 170 men and boys, from that to 200, just as the trade requires it.

2532. Do you employ any females down your mines?—Not any.

2533. Are they employed on bank?—No, not any with us.

2534. Will you state to the Committee the precautions which you, as a professional man, are in the habit of making, to prevent the accumulation and consequent explosion of foul air in the mines under your care?—Taking care to have good ventilation is all the means we adopt.

2535. Are you under the necessity of using the waterfall, the furnace, or the air-pump?—We seldom have recourse to the waterfall, excepting in cases where the air-road or air-course may have accidentally become stopped up, which it is liable to in case of the roof falling in; and in that case stagnation takes place, and we dare not apply the furnace, for the gas would come in contact with the flame of the furnace, and so cause explosion; the means then is to employ a waterfall, but that is very seldom done. In the mines where there is very little sulphur or foul air found, the mode to force ventilation is either a fire-place at the bottom, which is in fact a furnace, but not to the extent or large construction as they have them in the north of England, or hanging a lamp of fire in the up-cast shaft, or a chimney at the top of the pit, which is a sort of tube similar to the plan that they used previous to the furnaces being employed in the north of England.

2536. What is there termed the horse-head?—Yes; these are all the means that we use; but in the principal pit that we work, and where the most gas is found, we get an extraordinary quantity of air by means of having a high-pressure engine upon the pit employed for other purposes, but which at the same time answers very effectually to ventilate that pit, more so than any other means that can be used, except the air furnace that they have in the north of England, that I am aware of. That engine is used for the purpose of drawing the coals up an inclined plane, consequently it exhausts its steam into the upcast shaft, which steam, when it is in that shaft, has the effect of causing rarefaction to a very great degree, and by that means we have always found that we have had an excellent good air in that pit. That is applicable only to ventilation, where the engines are required for other purposes. It would not answer to put an engine into a pit for the express purpose of ventilation. I name that as an expedient. We never have occasion to place a lamp or furnace, or any other means for ventilation, where that is in operation.

2537. You are alluding to a particular case; what is the estimated power of that engine?—Twenty-six horse.

2538. Can you give the Committee an idea of the extent of your workings in acres in that pit?—At present we are about 500 yards from the bottom; to the utmost extent we have been, 600 yards; at present we are working about 500 yards.

2539. What is the extent of your air-coursing?—We never anticipate having it less than four feet square.

2540. And what length does it run?—It runs, in the present state of the pit, I should think, 800 or 1,000 yards before it returns to the up-cast shaft.

2541. Do you find your wastes full of explosive gas?—Sometimes we do where there is space, but we find that the roof is of such material that it frequently falls down after the coal has been gotten, and fills up the space.

2542. But you are aware that that falling in will never be supplied, for a long period of years at least?—I do not apprehend that in that period there is much space for gas when the roof falls in.

2543. Is it stone?—It is fine clay and bass, and is kept up with timber in the working.

2544. But, in point of fact, you have not found it to be a magazine of gas similar to what is known in your native country?—I have frequently found it as such in certain seasons of the year, as far as there was space to contain it. An open space is never found at a greater distance from the face of what is called post and thirl work, than 15 yards, but frequently less than that; and in long work it breaks down the roof very near the face, thereby leaving no room for lodgment of gas; but in our sulphur mines gas will lodge where there is space to contain it.

2545. Your saying that the gas lodges, does not that prove that the ventilation is not complete?—We cannot prevent that under any other mode of ventilation.

2546. Will your ventilation blow it out when you wish?—No, nor will any other ventilation; you cannot ventilate through the goaf, which is all deranged by the coal being gotten.

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2547. As you are intimately accquainted with the uses of the safety lamp, have you deemed it expedient to bring it into use in those mines?—Yes, as far as it is in my power; but there is a greater difficulty to bring the men to work with it in that country than in the north of England; there is no great difficulty in getting them to take it in when there is danger, for instance in the morning, to see whether the work is clear; but I should apprehend there is great difficulty to get the men to work with it as a working implement; that supposing the mine was to get into a bad state of ventilation from gas of an explosive description, I have a faint hope of getting men in that neighbourhood to work with the lamp altogether, without paying a very serious extra expense for so doing.

2548. From your knowledge of the seams would that be a reasonable demand?—No, I do not think it would.

2549. Do you conceive that they would have cause to complain of compulsion to use the lamp on the part of the owners?—I conceive that in many cases there is no more reason to pay the men extra than there is in the north of England, for I was there when it was introduced; and though there is a small difficulty in working with the lamp, yet the men in the Staffordshire collieries would consider it a very great difficulty, as far as I have had an opportunity of discovering, and I think the masters at present would be obliged to give an extra price.

2550. Are the men your masters?—That is a very serious question; they do what they can to be so.

2551. You are aware that prejudices against the lamp existed in the north at the time of its introduction?—Yes, very great, as regards the difference of light, but not its utility.

2552. Do you see any reason why those prejudices should not give way in Staffordshire, as they have done on the banks of the Tyne?—Not any; and my opinion is, that the prejudice must give way, for in process of time the mines have such an inclination to dip, that subsequently the coal will have to be gotten very deep, and there will be more gas to contend with.

2553. What is the usual inclination there?—About ten inches to the yard.

2554. And the deeper you go, your experience proves that you are more liable to the evolvement of gas?—Yes, it has been generally found so.

2555. In point of fact, have you found the workmen resist the introduction of the lamp where you have recommended its adoption?—No, not to try whether the place was safe; but I never could prevail upon them to work with the lamp generally; I could prevail upon them to work for a day or two to get over serious obstacles, to hole a place that could not have been done without such assistance; but I have never had a call yet to work a pit with lamps. Though I am afraid I should have a difficulty in prevailing upon them generally to use it in working coal, and we have always got the mine into such a state of ventilation, where danger has approached, as to enable them to work safely with a candle.

2556. Can this danger have arisen from any want of confidence in the Davy, from accidents happening with it?—No.

2557. Have you ever had any accident with the lamp?—No, I never had; I know an accident with the lamp, which I think clearly proved what Mr. Buddle stated relative to the liability of the flame to be blown out, wherein a man lost his life in our neighbourhood; there are a pair of pits 314 yards deep.

2558. Can you name the pit?—It is Green Dock pit; they made an excavation in the mine at that depth, expecting it to prove a mine of coal, which failed, and which excavation filled full of gas on a very hot day. I believe the pit had been standing for awhile, to consider whether some other arrangements were not necessary to be made, without pursuing this thin mine further, and the agent and two men went down the mine; I saw them go down myself; he came up and left them, with the safety-lamp to work with, to make preparations to mine away a stone drift. When he came up, a ringe of water was thrown down, by whose directions I do not know (I was not there at that time), with the idea of increasing the ventilation of the pit, which it would do ultimately. As soon as ever that water was thrown down the pit fired, evidently proving to me that the water, making such a great pressure in the downcast shaft, caused such an intense current of foul air into the lamp, that the flame passed through and so fired all the sulphur. One surviving man, who was sadly burnt, said, that as soon as ever the great wind came, which was in fact sulphur to them (they were at the bottom of the upcast shaft), the gas exploded immediately, thereby proving to me that that is the only way in which we have ever found the lamp unsafe.

2559. He

2559. He described it to me, that the current was a violent, intense gust?—Yes, coming from the effect of throwing the water down the downcast shaft.

2560. Which had the effect of throwing the sulphur upon the gauze wire or lamp?—Yes.

2561. Was this the first time that you had ever occasion to suspect that the gas could be forced through the gauze?—I had never seen it do so; it was always admitted that it was possible to be done so, but I had never any instance wherein the possibility of it was proved so clearly.

2562. You are now aware that Sir Humphrey Davy warned the miners of that?—Yes; I was not aware of it till I heard Mr. Buddle's evidence, and I believe this is a proof of the correctness of the prevailing idea.

2563. The Committee understand your evidence to have been confined to mines that are under your care; do you know any peculiar circumstances, different from your own, relative to the mines around you?—I have been in several other mines in our neighbourhood, besides ours.

2564. Are those mines more dangerous than your own?—I do not know any more dangerous, but many have no sulphur in them at all.

2565. Is it the general practice to work with a candle in those mines?—Yes, except in very rare cases, for a limited time.

2566. Is the relative expense of candle-light and lamp-light the cause of objection with the miners?—No; the master generally finds the lamps and the oil, and the wicks that are used are not more expensive than candles; I believe the lamp itself is an extra tax upon the master.

2567. But that can be no objection, when it is found for the men?—It is never doubted by the proprietors of the coal-mines; wherever it is necessary they have always a quantity ready for every purpose.

2568. From your own personal observation, is there any difficulty in a man doing the same quantity of work, as well in your mines with a good Davy, as with candles?—I do not think there is, where it does not require powder to work the coals.

2569. Do the men use lamps with powder?—No; the very idea of using the lamp prevents their using powder.

2570. That is no obstacle to the use of the lamp?—None whatever; the man suffers if he is working by the piece, inasmuch as it requires extra labour to get that coal, where powder would be an advantage, and in that case the masters generally make or ought to make an allowance.

2571. But though he was working with a lamp, he might, by permission of the viewer or overman, such viewer or overman being satisfied of the safety of the mine, use a shot at particular periods?—Yes, if he was under inspection.

2572. Is he not under inspection?—Yes.

2573. Are there any parts of your mines in which you prohibit the use of gunpowder?—No, I do not know any where we prohibit it; but we leave that to their own judgment in getting the coal by piece.

2574. Have you ever known an explosion the consequence of a shot?—No.

2575. Have they always candles?—Yes; they generally work with candles, and we are always under the necessity of putting our mines in a good state of ventilation before they will go to work again after an explosion.

2576. Have you frequent complaints on that head?—No; when the pit is full of gas they discover it by means of the lamp in the morning, and they universally come out directly, and say that the pit is full of sulphur, and some means must be used to carry it off.

2577. Have you found it necessary to give the men those strict precautions which the wastemen and overmen are obliged to attend to in the north?—We always give them strict precautions when they go in the morning, and the man that has the Davys is under strict precautions to keep them safe.

2578. With regard to other accidents; have you many men lost in descending and ascending the shafts?—No, not many; I have lost one in that way, he fell out of the skip.

2579. Have you a particular contrivance for landing the men?—No; the men are not drawn up and let down again as the coal is; they step out when they are drawn level with the surface of the bank.

2580. They never cling to a rope in the manner described as practised in the north?—No.

2581. In reflecting upon the modes of working with which you are familiar in the

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the north of England, has the practice of the district in which you are now engaged suggested to you any idea by which the safety of the north country mines might be increased?—No, I do not know that it has; I do not see that they ever could get the quantities in the way that we work, which they do in their own way.

2582. You mean to say, that you think that the mode adopted in the north is equally safe with your own, and that they are enabled to get greater quantities than they would obtain by the adoption of your system?—Yes, they do get greater quantities, and I do not know that our system would be more safe than theirs.

2583. Does it strike you that the principle of long work might be applied to that colliery?—It would appear that if the roof should break down close behind the work, there would not be that space for sulphur or foul air, and so no room for sulphur. The current of air passing along the work would, I think, keep it clear, and so might prove an advantage. But in many cases in the north they have a post or stone roof, in which case it would stand perhaps for 40 or 50 yards upon an area. I do not think that long work could be at all practised there, for it would never break down behind them, and there would be ten times more space for foul air than there is now.

2584. You are well aware of the nature and objects of this inquiry; the Committee are anxious to know whether you have anything to suggest to the Committee in pursuance of the objects of their inquiry, connected with the greater safety and preservation of the workmen employed in the mining districts with which you are acquainted?—I do not know that I have anything to offer more than that good ventilation should be kept up, to contend with sulphur or with gas.

2585. You have no new method of ventilation, beyond what you have seen and heard, to suggest?—No.

2586. What is your own confidence in the safety-lamp?—Perfect confidence. I dare go amongst any quantity of sulphur with the safety-lamp, provided I could feel myself guaranteed against the liability which I have just named of anything which would cause the sudden motion of the gas. I have tried it in every other case wherein it is possible to be applied.

2587. You are aware that danger may arise from its being too long filled with lighted gas?—That is the prevailing opinion that we have; but we never attempt to keep it long after it appears to get red hot; the men always make away directly. With us they are not inured to face the danger, as they are in the north of England; whenever it fills with fire, they generally find it their business to withdraw.

2588. You are aware of the fact that the pitmen in the north, knowing that there is a magazine of 20 yards of combustible air within where they are working, never discontinue their work?—Yes; I was deputy overman at Killingworth colliery for 12 years, and we never had an explosion, though we worked a pit altogether with the lamps.

2589. Were you there at the great explosion?—No, I went there directly after.

2590. Is it not your practice to wall up your magazines of gas?—No, that is always found improper. They have a method in the Potteries of doing it, which I consider unsafe. I never allow it where I am.

2591. Have not very serious accidents arisen from that?—I did hear of one.

2592. What is your reason for considering that practice unsafe?—Because the gas oozes out through the cracks of the coal, and the coal is of a tender nature.

2593. In point of fact it is a false security?—It is; and if a person should happen to put his candle to that oozing out, he explodes the whole quantity shut up, and the consequence is that serious accidents would be the consequence. The largest accident that happened in our neighbourhood was from that cause, I believe.

2594. Where was that?—At Appedale. They had made it up with stoppings.

2595. What number of lives were lost?—I do not know.

2596. Was it 10 or upwards?—Yes, I think 10 or upwards.

Lunæ, 6° die Julii, 1835.

JOSEPH PEASE, ESQUIRE, IN THE CHAIR.

William Forrester, Esq., called in; and Examined.

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2597. YOUR residence is in the county of Stafford?—At Shelton, in the Potteries.

2598. Are you intimately acquainted with the mining operations carried on in that district?—With some parts of them. One of the principal collieries is the Earl Granville's works in Shelton, and which I manage.

2599. Are his Lordship's mines of considerable extent?—They comprehend 300 or 400 acres.

2600. They are held under lease from the Duchy, I believe?—Yes, under the Duchy of Lancaster.

2601. Perhaps you have had an opportunity of becoming acquainted with other mines in the vicinity?—A little; not much.

2602. Do the mines you superintend comprise all the strata, or nearly all the strata in that district?—No; there is the Bucknall district and the Adderley Green district are a different strata of mines to ours.

2603. They are a lower strata?—They are a lower strata.

2604. What are the principal seams in the collieries now at work; the collieries under your management?—The Kennel Row and the Great Row, Spencroft, Peacock, Bassey mine, Little mine, and Deep mine. We have other mines that we are not working, several.

2605. Are you working the Knowles or the Ash?—We are not; we have them in our estate.

2606. Are any of the mines so at work subject to fiery damp?—Some are.

2607. Which of these mines are the most subject to fiery damp?—The Great Row, the Kennel Row and the Deep mine; those are the most subject: there is some fire in the Peacock and the Spencroft, but no great deal.

2608. Have you had frequent accidents from the fire-damp in your mines?—We have had several accidents in the Great Row mine.

2609. Attended with serious loss of life?—Attended with loss of life two or three times. There were several burnt that did not lose their lives.

2610. What precaution have you been in the habit of taking to prevent such accidents?—We used to have a furnace in the bottom of the upcast pit. We have lately adopted another plan, we have a furnace at the top of the upcast pit, and we build a large chimney.

2611. That is, you close the top of the pit, and conduct the air to a furnace on the bank?—Yes.

2612. And then you have a tall chimney from that furnace?—From 10 to 15 yards high and four feet square, and round that chimney where the fire is, we have put a flue this time, the same as a boiler flue, and made the grate the same as a boiler grate, so that the air runs round inside the chimney flue which is lined with a course of fire-brick; the fire runs round in a spiral form into the chimney.

2613. Have you found that an effectual mode?—It seems to me to act quite as well as the fire made at the bottom of the pit. We formerly put it at the top of the ground, near the bottom of the chimney, without a flue round it..

2614. What do you consider to be the advantage of having the fire at the top of the pit instead of the bottom?—We have sometimes had accidents from kindling the fire at the bottom of the pit; we have got it to the top because sometimes the pit would get so full of carbonic acid gas that we had great difficulty in kindling the fire; and I consider the rarefaction is better near the top than at the bottom of the pit.

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2615. Were there any explosions in kindling the fire?—I have known explosions several times after kindling the fire; there was never any person caught with it, but I have known an explosion or two within the last 30 years.

2616. You have never adopted the plan of drawing the air to that shaft by another level, so as not to pass over the furnace?—No, we never did; we never adopted that plan; we always have a very strong current of air.

2617. What is the mode of working coal in those mines?—I am quite unprepared with any sort of section: I just sketched that out this morning (*handing in a sketch*); that pit comprises from 70 to 80 acres of coals.

2618. Which coal is that?—That is the Great Row coal. It is the coal where we have most of the accidents in.

2619. The air chimney is upon the upper level?—Yes, and we have a chimney on the lower level; our mines dip one yard in four, and it is the head of the work above the level that the coals are all wrought from.

2620. Then the chimney is upon the upper level?—Upon the upper level.

2621. And the working pit and engine pit, as here described, are on the lower level?—Yes.

2622. Is there an upcast pit on the lower level?—Yes, there is another upcast pit at the lower level, so that there are two upcast pits that are taking air from those pits.

2623. What do you call this head-work?—Post and thirl work.

2624. Do you take the coal entirely out of the ground, or leave any portion of it?—We leave a very small portion; there are three rows of posts which are left standing, and when working we make another thirling above. We take out the lower row of those posts as much as we can, nearly all. We have in general three rows of posts standing, but sometimes only two rows of posts.

2625. Do you work all the mines you have described on the same principle?—We do not; all the other mines we work on the long-work principle.

2626. Which mine is this you have described?—The Great Row mine.

2627. What is the thickness of this coal?—Ten feet.

2628. What is the nature of the roof?—It is a very soft or heavy marly roof.

2629. And what is the nature of the floor?—A soft marly floor that gives up.

2630. Then, notwithstanding the softness both of the roof and the floor, you are able to take the whole of this coal out of the ground, with the exception of a small quantity?—It drains very dry in consequence of the inclination of the mine being one yard in four, so that it will be quite dusty under the coal.

2631. Now, can you state the per centage which you apprehend you will lose in the course of working?—Something less than 20 per cent. we consider.

2632. Are you at all aware what proportion that bears to the quantity obtained in the six-feet seams, in the north of England?—I am not.

2633. What precaution do you take with a view to the ventilation of the mines under your care?—In driving out, we take a water-level or an air-head, and a level or drawing-road; we draw the coals along that level to the pit, the same as described in the sketch which I have placed before the Committee.

2634. Is it your plan, after sinking a pit, to drive levels to the extremity of the field you intend to work?—Quite so; the level is driven so.

2635. And do you then commence getting coal at the further end of that level?—Yes, at the further end of that level.

2636. And so bring the work back to the pit?—Always so.

2637. Well, then, do you find that in that portion of the field where the coal is worked out, that the air is apt to collect in great cavities and to be dangerous?—It is, very. We generally make the stoppings up in the face wall against the waste, as close as we can; as we wish to fill the cavities as much with carbonic acid gas as possible.

2638. Then the air passes between those excavations and the face of the coal?—It runs through those three places where the posts are left regularly into the air-head, across the working; it goes up the air-wall, and spreads itself into the different thirlings between those posts; it expands, I apprehend, and fills all that space there.

2639. Then have you frequent accidents in other parts of the works?—We have not: we have never had any serious accidents in any other mines; not with the fire; very little.

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2640. In what part of the works do the accidents from fire-damp occur?—We have had accidents in the first drift of walls in that field.

2641. How long have you been employed in the works?—Thirty-two years.

2642. How long have the works been under your direction?—They have been under my direction above 23 years.

2643. Now, during that time, what has been the average number of accidents, compared with the number of men working; I mean from all causes?—I should think there has not been 20 men killed in the whole 30 years.

2644. Not by fire-damp and other accidents?—I should think not. We have no account of the quantity, but I should think not.

2645. Then what proportion of those men have been killed by fire-damp, and what by other accidents?—I should think, perhaps, two-thirds of them by fire-damp, and the other by accidents; by coals falling upon them, and falling down the pit; one or two accidents of that kind have happened.

2646. Drawn sometimes over the pulley?—I have known of accidents happening by men being drawn over the pulley, but not a fatal one.

2647. Do you find that the plan you adopt is sufficient for the perfect ventilation of the mines?—Yes, in a general way; it takes away the whole of the fire-damp, and makes the works very workable. It is when we get a very heavy weight from above, sometimes 40 or 50 yards square, before there is a falling in; after a weight of that sort, it brings down the carburetted hydrogen gas from above, which then sometimes gets up into our workings, and without care, they get an explosion.

2648. Do you make use of lamps in your mines?—We do at those times; but it is with very great difficulty that we can get the men to use them.

2649. They usually work by candle-light?—They do.

2650. And you only use lamps in cases of apprehension?—When we have the fire-damp about us, and then we enforce the use of lamps; but we are compelled to give the men 2 *l.* a month extra for using the lamps.

2651. When men have occasion to work by lamps, you are then obliged to give them 2 *l.* a month extra?—Yes; the last accident that we had was in that pit; there was a fire in it three or four days before the accident happened, which was a sort of caution, and I ordered the lamp to be used, and some part of the workmen were using the lamp; in a day or two after, at breakfast-time, they called out some particular word they use, and the men all ran to a certain place to their breakfasts, and there were two or three young men in the pit——

2652. What depth is the mine?—Two hundred and five yards deep.

2653. That is the Great Row seam?—That is the Great Row seam.

2654. There are not many pits in that neighbourhood deeper?—There are some at Lane End deeper.

2655. To the same seam?—No, not to the same seam; none so deep in the neighbourhood.

2656. How do you account for your having more fire-damp than the other colliers in your neighbourhood?—Because, in working the Great Row mine, we take about six feet out in the first place, and leave what are called the roofs and pillars; the roofs are about three feet thick, and before we get out the lower row of pillars to the level, we get the roofs, and then rob the pillars as much as we can; and it is in the space that is left where these roofs have fallen down and pillars got out, that the sulphur or fire-damp will accumulate, and above the level of the working coal.

2657. Now, you spoke of your system being to drive to the very verge of your boundary; in such a case, how many yards would your head course run before you turned it?—On the north side of that pit it is near 1,200 yards, straight northward; on the south side, the level is near 600 yards; so that the whole length of level is about 1,800 yards.

2658. But do you mean to say the whole of that level is completely worked out before you attempt to make any side workings?—Yes; we drive to the back, as we call it, that is, to the boundary, before we attempt to get any out of the walls.

2659. Do you work double or treble shifts on such occasions?—We always work night and day.

2660. And what width do you take before you?—We take the level or drawing road, nine feet at bottom and four or five feet on the top.

2661. Do you remove the whole of the ten feet on that level?—No; we leave

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nearly three feet up to a parting; there is a regular parting generally between two feet eight and three feet.

2662. Do you require any propping as you go along?—None.

2663. The parting constitutes a good roof?— It does.

2664. How many yards in the 24 hours will you drive?—About a yard and a half is considered a man's work in driving forward. But generally in that level there are two men employed and a boy.

2665. Then keeping them continuously at work, two men and a boy, how many yards will they advance in 24 hours?—About three yards; the levels go from 18 to 20 yards a week, nearly in that proportion.

2666. Can you give the Committee any idea of the length of time you were occupied in sinking this shaft down to the Great Row seam?—We were very near 12 months in sinking those three shafts. We formerly used to have but two shafts, and we found we were plagued for air in having only two shafts, because when the air separated at the bottom of the downcast pit, to air both the sides of the workings, sometimes one side took more air than the other; we were obliged to regulate it.

2667. Then what is the diameter of the present shafts?—Seven feet.

2668. Are both shafts the same?—Yes; we work a single rope in each shaft.

2669. Now, do you recollect the period that elapsed after sinking the shaft before you reached your boundary with your levels?—A little more than 12 months on the longer side, perhaps eight or nine months on the short side.

2670. But the longer side being completed, you commenced coal work?—But we commenced coal work when we completed the short side first.

2671. Then a period of two years elapsed before you received any returns on the capital invested in the mine?—No; on the shorter side I should think we were not more than eight months certainly, after the pits were sunk.

2672. Then it would not exceed 20 months before you entered upon the operation of your works?—We partially entered upon them at the end of eight months after the pits were down; we started seven or eight walls at the end of eight months, while we were driving out the other side. The sides were unconnected; we had two separate downcast pits, and therefore the air was not connected except at the upcast pit.

2673. Do you wish the Committee to understand that the whole of this operation is carried on for the exclusive purpose of ventilation; has it no connexion with the more economical working of the coal, or the draining of the seam?—It is for the economical working of the coal, as well as for the airing of the pit. A great deal of the coal would be lost if we did not begin at the far end first.

2674. Do you allude to the pressure upon the posts and thirlings?—It would throw the work altogether in, if we were to begin at the 400 yards instead of the 800 yards; it would inconvenience the pit very much, for the coals that were left behind we should lose a considerable quantity of; all our roads would be injured, and in the part worked we should get an intermediate space filled full of carburetted hydrogen gas, between the further end work and the nearer end work.

2675. That is to say, in case you left your passage scanty?—Yes, if we were to begin to post and thirl it before we got to the far end of it. I have known, in driving out a level, when the former pit has been worked out too soon, I have known walls started along the level, and they have been driven five or six yards up, but they are very dangerous places; they become lodgments for sulphur or hydrogen gas. I have known them driven five or six yards, but it has been from necessity, when we have not had coals to go on with, perhaps 20 years ago; we found it a very bad plan to work it in that way, because those places got full of hydrogen gas.

2676. Then in point of fact the mine is first cleared at the highest part of it?—At the lowest part of it.

2677. Do you drive under dip?—We drive up dip; we are compelled to do that by the dip of the mine.

2678. Do you draw all the coals up hill?—We draw them all down hill to the level, and along the level to the shaft; the ventilating shaft is on the lower level.

2679. When you turn out of the levels, you call that setting up, do you not?—We call it starting a drift; we sometimes take about four or six, or eight or ten walls, according to the quantity of coals we wanted to get. We are now working about six walls, six and seven walls at a drift.

2680. And when you have taken these walls out in any intermediate space between the pit and the extreme boundary, you have found that the space left has accumulated

mulated foul air?—Yes; but it is very general with us that the face wall being stopped very close, the waste gets full of what we call choke-damp, or carbonic acid; it is only where the carburetted hydrogen gas is very strong (from a weight that we get from the top), when we have a great space open, that we feel any effect from the carburetted hydrogen gas; and by keeping the stoppings up, and keeping the first open thirling in the face wall pretty high, so as to keep it as much on a level across the thirlings as we can; that part which has been got is generally full of carbonic acid, mixed in some cases with hydrogen gas, no doubt.

2681. There have been instances in that country where they have walled up those excavations in the course of the workings or drifts, have they not?—It would be impossible to wall up in a place like that, in a ten-feet coal, where we get out the whole of the mass; where we get out the ribs and the whole of the coal ten feet; it falls in 10 or 15 yards high.

2682. But in instances where you have stopped the course of the level, you have got coals before you have gone to the extreme boundary?—We never got them above six feet high; sometimes we thirl them one into another.

2683. Have you ever experimented on the waste, or what is called in the north of England, gothe, to ascertain whether there is any constant exudation of carbonic and hydrogen gas?—I do not conceive there is a great deal comes from the bottom.

2684. Have you ever tried it along the face?—In driving a level, I have perceived some come from the bottom and a blubbering up in the water. It might come out a little when it is first opened at the bottom.

2685. Are you ever prevented by the foul state of the mine from carrying on your works?—Very seldom.

2686. For a day or two?—I hardly ever knew them to play a day in my life after a fire; the last fire, and the worst fire we ever had, they were at the top of the work in an hour after.

2687. What number of accidents at that fire and at other times, and what number of men have been lost?—I should think not more than from 20 to 30.

2688. Was that by fire-damp?—By fire-damp and other accidents.

2689. Now, do you consider you have been more successful in avoiding accidents than your neighbours, or otherwise?—We have been pretty successful; our neighbours have some of them been more successful, and some of them very much worse.

2690. Can you form any idea of the loss of life within the last 10 or 20 years in the district constituting what may be called the Pottery district?—No, I am sure I cannot; I should think perhaps 100 men in the whole district.

2691. In 10 years?—Not more than 100, I should think, in 20 or 30 years. There is a great extent of mining country, if you take the whole neighbourhood in.

2692. Did you mean your answer to apply to 10 or 30 years?—I should think not more than 100.

2693. Not in the 30 years?—I should think not; I cannot tell.

2694. You have kept no account?—No, I have not.

2695. Do you know any one who has kept an account?—No, I do not; I do not think any one has in our neighbourhood.

2696. Is there any scientific gentleman, or other person, who keeps an account of local fires within your district?—I do not think there is. I should think that there would be an account from the North Staffordshire Infirmary, of how many men have gone to that infirmary the last 10 or 15 years.

2697. Of course the dead are not removed there?—They are not removed to the infirmary, certainly not.

2698. Now, have you found it necessary to use the safety-lamp as an instrument for regular work?—I have used it for three months together in that pit, or four months.

2699. And then abandoned it again?—Yes.

2700. As being yourself well acquainted with coalworks, was the extra wages which you say you were obliged to pay your workmen at such times they used the lamp, in your opinion a reasonable demand?—I think it was. I think they could not do so much work with the lamp as they could with a candle.

2701. Did you find it so that they did less work with the lamp?—They do less work with the lamp; the lamp does not give so good a light as a candle; they cannot

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not put the lamp in the oblique direction that they can the candle, particularly in cutting up.

2702. Do you lay nothing to the account of prejudice?—There has been a good deal of prejudice against lamps, especially 10 or 12 years ago; so much so that Mr. Wedgewood, the Member for Stoke-upon-Trent, in the last Parliament, had a communication with Mr. Buddle, and I have the communication that was carried on between Mr. Buddle and Mr. Wedgewood at the time; it was about the time when Sir Humphrey Davy was down in the mines at Newcastle-upon-Tyne.

2703. But do not you think that the lamp when well managed affords quite a sufficiency of light for working in such a seam as you have been describing?—No; it is not so convenient by a great deal in a thick mine.

2704. Will you describe the inconvenience in cutting the roofs?—It is very inconvenient to throw light into the roof cuttings.

2705. Are there any fissures or cracks, or what are called backs, which they wish to follow with the pick?—No; the walls are carried up pretty straight, as you may see by that sketch.

2706. And you really think that 10 *s.* a week was a fair allowance for the difficulty of working with the lamp?—I think it was no more than a fair allowance for 10 or 11 men.

2707. What is the average wages paid by you?—Four shillings and fourpence a day.

2708. Do they work day-work or piece-work?—Piece-work; but the day wages are considered 4 *s.* and 4 *s.* 4 *d.* a day.

2709. What length of time are they occupied?—Twelve hours, taking an hour and a half out for dinner and breakfast.

2710. And will a good workman on an average make 28 *s.* per week?—Twenty-four shillings or 26 *s.* by bargain, they will.

2711. Working what number of hours?—Ten hours and a half.

2712. Do you generally employ your men by wages or by bargain?—All by bargain, every man, unless it is a little job that we cannot set a bargain upon.

2713. Is it by the ton or the basket?—By the ton.

2714. What do you estimate the ton at?—The getting of the ton?

2715. Yes?—About 3 *s.* 4 *d.* a ton, on the average; but the slack we reduce into coal so as to call it coal by the ton, so that they get about two tons of slack for one ton of coal.

2716. How many days a week do your men work?—They have lately worked five or six days, or they might have worked if they would; but they are very obstinate at their work at the present time; they have got the trades' union among them.

2717. Have you many men that earn more than a guinea week?—I should think many do, but not round the Pottery; at a distance; round the Pottery they give less wages, 3 *s.* 6 *d.* a day.

2718. But when you say 4 *s.* a day, I want to know whether working six days or five days or four days a week?—I think many might work six days a week; but I do not think many do work six days a week.

2719. But practically?—Five days; I should think they hardly average more than that.

2720. What quantity of coal does a man get in a week?—About 30 tons in the Great Row.

2721. One man?—One man.

2722. Then it is not 3 *s.* 4 *d.* to one man?—No; there are bottomers and loaders, and candles and timber, that they must use; post wood, horses, and so on.

2723. But out of those 4 *s.* a day do they find their own tools?—No; we let the pit to charter-masters (the foremen), and those men find the tools for them; they work for them at so much a yard, or so much a day, and find no tools.

2724. How many men have you employed?—About 200 in coal-getting.

2725. And in your pay-list, how many do you pay 26 *s.* a week?—Perhaps about one-half.

2726. The 3 *s.* 4 *d.* includes all the expense of coal-getting, I suppose, in fact, down the pit?—Taking all the mines together.

2727. Then a man must hew more than a ton a day?—Yes; three to six tons a day, according to the mine.

2728. Your practice is to set a pit to a certain number of men who have the management

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management of it?—Two or three of the best workmen; we generally pick the best workmen to undertake the pit.

2729. And with whom alone you are accountable?—Yes.

2730. And of course they pay the colliers, the other men, as they please?—Yes; but I regulate the price per ton that they shall give them, or per yard, whichever it is, so that I see that the charter-masters do not impose upon the workmen.

2731. And a pitman, I suppose, employs his family or lads to help him?—The workmen's children all go to the pit work; many men we get from Newcastle-on-Tyne, Shropshire, and south of Staffordshire, and Wales.

2732. Is there any scarcity of colliers in your district?—At the present moment I think colliers are rather scarce, in consequence of opening the iron-stone mines.

2733. How long is it since you were under the necessity of working your mine by the safety-lamp for the space of three months?—Three or four years ago; it is three years ago, perhaps.

2734. Do you consider your mines in a better state ever since?—No, they are much in the same state now as they were three years ago, and if the men were to go into the same places that they went in at that time they would fire it.

2735. Had you any accident with the lamp at the time you used it?—We never had an accident from the lamp; I have seen a lamp fire the carburetted hydrogen gas in a current of air in a thirling.

2736. Was that current of considerable velocity?—It was; it would blow a candle out.

2737. You say this current struck the lamp and ignited the gauze?—Yes, and flew away; it flew away with the air, and went out.

2738. At what distance beyond the gauze did the fire take place?—It seemed to fly close from the gauze.

2739. Did any accident follow that circumstance?—It did not.

2740. Were you more careful afterwards?—We were very careful, or we should have had accidents, for it was a fiery place; we could not go more than four or five yards from thirling to thirling.

2741. Do you conceive that any of the accidents which have since occurred would have taken place if you had been in the regular habit of using the lamp?—I think not; that accident that did occur would not have taken place if they had used the safety-lamp; but when there is no necessity for using the safety-lamp we always use the candles, although there is always a large quantity of hydrogen gas in the wastes.

2742. Then do you conceive that it is the extra expense, or the prejudice of the workmen, that compelled you to abandon the use of the lamp?—We never do abandon it, we use it regularly when it is wanted; we are using it in some parts of the work daily.

2743. Then at the period you alluded to the mine was wholly lit with candles?—Yes, the mine two or three days before was wholly lighted with candles, but they had a little fire, a very small fire, which warned them to use the lamp, and they were using the lamp up in the walls where the danger was; but at the breakfast hour the men called out something, I forget the word at the moment, but they all immediately ran from their work as hard as they could to what they call the dinner bank; and there were two young men in the pit, active young men, and to be the first at the dinner bank they ran through the waste and openings where the gas was accumulated, and forced it out into the air, which carried it into a candle that was at the edge of the wall, with a rush; the man rushing through the thirling forced the hydrogen gas into the candle, which was the cause of the accident; and the man admitted that it was he that had done it. He lived but a few days after the accident, and he admitted that it was he who had done it, by running through the gas and forcing it into the candle.

2744. Did any of the others suffer?—Others suffered, and four or five died; they lived about a fortnight or three weeks at the infirmary.

2745. Now you have spoken of small fires; in these cases men are very severely burnt and injured, although not absolutely destroyed?—In the small fire I mention, one was very little singed, not so much as to disable him from working; they are not often so large as to burn the men, small fires of that sort.

2746. Have you a great many men burnt from time to time, who are not killed?—Not a great many; generally, when some of them are burnt, there are some of them that die or are killed.

2747. And supposing that in your own opinion it was expedient to introduce

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the lamp, do you apprehend that, in consequence of your men being in the unions, they are sufficiently united to prevent its introduction?—Yes, if they were so inclined; they are in the Potteries so united at the present moment that they are compelling the potters to do what they like; they will allow no master potter to discharge a man at the moment; if he does, the whole of his workmen will turn out. Yates and May's men have been standing out 13 or 14 weeks now for an advance of wages, or some principle in their wages, and who are the Earl Granville's customers. Last week, or about 10 days ago, a gentlemen received a letter from the union, to say that some of his men were in arrears with the union, and if the master did not immediately make them to pay them up, they would turn his bank out. That was Mr. Mayers, of Lane End.

2748. Then you are not only obliged to listen to the men, but you are under the necessity, as it were, of hammering your own chains?—We are at present in our works resisting the union as far as we can. Our men dare not acknowledge to be in the union, because they know I have Lord Granville's orders to discharge them instantly; but they act as if they were in the union, and I have reason to believe they are in the union; they will knock off work at any hour of the day they think proper, and go away.

2749. Do not you refer to the magistrate in that case?—No, I have not done so; we have thought it the better mode to allow them to go away, and get others in their places as soon as we can.

2750. With regard to ventilation, you have spoken of an improvement in removing the furnace from the bottom of the pit to the bank, and then rearing a tall chimney to that furnace?—Yes.

2751. Have you ever discovered whether you had a greater current of air down the downcast shaft in consequence?—I think quite as great, and quite as regular a current.

2752. Have you attempted to gauge it in any way?—I have.

2753. How have you tried it?—I have tried it with a candle, but nothing else; it would blow the candle out.

2754. Did that experiment prove that you had a greater body of air, or that it moved with a greater velocity?—I am quite of opinion that we have a greater body of air in working the mine that we are now working, than we have had before. We get a sufficiency of air to work it generally, without using the safety-lamp.

2755. But you can hardly speak of obtaining the same air, when from time to time you have men burnt?—These accidents are almost always brought on, I would not say carelessly, by the men, because it is accidental; but I hardly ever knew a fire but what was occasioned by some thoughtless misconduct of the men.

2756. Describe the instances?—In the instance of this man that ran through into the gob, (the last fire that we had,) he ran into the waste, and by that means forced out the carburetted hydrogen gas into the road, and it took the candle.

2757. Do you know of any other instance of neglect on the part of the workmen?—I cannot say neglect; I wish to qualify that term. It has been fired from men incautiously trying it too far; some of the men are very venturesome in trying it by the use of the candle; I have known them fire it by trying it.

2758. Do you ever use lattice work?—Not in the pits.

2759. But do you in the boards, to direct the current of air?—We have brick and mortar stoppings.

2760. But if you want to direct the air on the face of a man's work, how do you proceed?—By stoppings or sheetings put across the thirlings.

2761. Do you ever encounter what are called in the north blowers, or sudden discharges of gas on the face of the mine?—We do, in driving a level in a coal we have been lately opening, which is only 21 yards from the surface.

2762. Have you heard such a term as a bag or sack of foulness coming out upon the mine?—No, I never heard the term.

2763. Have you any fissures or backs in your coal, on the approach of which you suddenly encounter magazines of gas?—Sometimes we have; frequently; it comes in very large quantities out of the fissures.

2764. How would you expect to avoid an explosion in such a case, working with candles?—We should use the lamp till we got beyond it.

2765. But supposing it rushed out instantaneously on the man?—I never met with an instance where it rushed out instantly, so as to do any mischief before the man could get away from it. In the pit I just mentioned, in 21 yards we met with more fire-damp than I ever remember to have met with. At 190 yards from the

the pit there we came to a dyke or fault where a sudden stream of hydrogen came out, flowing from the slip or dyke.

2766. You think the furnace on the bank provides you with more air than it does below?—I do think it does.

2767. On what principle do you account for that?—I think the flue round the top of the pits heats the bricks, and helps to rarify the air; besides the fire that goes into the chimney, it naturally runs round the flue into the chimney, the same as it would round the boiler.

2768. You spoke of the area of that chimney being four foot square; is that at the base of the stalk?—It is four feet all the way; all the same size.

2769. Do you ever know any of the air explode in the shaft?—I have known it explode at the chimney, where the chimneys were made in the common way. There is a fire made straight into the chimney, instead of the flue going round it. I have known an instance of it taking fire at the top of the pit, at the chimney.

2770. And blasting downwards?—Yes; but there were no men in the pit at the time, and so no mischief was done by it.

2771. And you have been working with naked candles in the pit at the same moment?—No.

2772. How do you account for it that the air exploded at the base of the chimney, and did not explode in the mine with the naked candle?—Most of the gas must be got up towards the top of the pit; they were not at work in the pit at the same time; they had been at play at that time, a day or two. About a month ago, at one of the pits, we had a similar fire at the bottom of the shafts, where we have a furnace for ventilating; one of the men made a fire in it; I particularly cautioned him not to do it until the pit was cleared of the fire-damp, which we could do by throwing water down the pit, by a waterfall from the pumps; he was the bailiff too; he thought there would be no danger, and he went down and kindled a fire, and he had not been out ten minutes before it fired.

2773. Were there any other men in the pit at the time?—No.

2774. Did the explosion extend through a great part of the work?—There was not a great part open, or else it would, no doubt; it exploded all the gas in the pit.

2775. Are you also acquainted with the shaft mentioned by a witness the other day, in which the sudden ejecting of water into the pit caused the lamp at the bottom of the pit to explode?—I am not acquainted with it; I heard of it; I never was in it.

2776. You have no personal knowledge of the fact?—I have no personal knowledge, no more than report. There is no doubt that that was the fact; that it was a gust of wind that blew the gas into the candle.

2777. As a workman yourself in the pit, would you consider it reasonable for one of the owners to compel you to work by the lamp, under the circumstances in which you are now working this Great Row seam?—Certainly; or we might stop the pit in some particular cases, where we meet with mushes or faulty coal, which we do in driving up those walls that are faulty and bad coal, as sometimes there comes a great deal of gas from those places, for perhaps 10 or 20 yards, in working those drifts; then if we did not work with the safety lamp, we should be sure to have accidents often; but I never allow the men to work where the gas burns in the lamp, we wait till it drains.

2778. Then the most reasonable course you conceive to be, that which you adopt, of daily deciding whether the safety lamp is to be used, and where?—Yes.

2779. Is that your practice?—It is our practice; we sometimes do not use it for twelve months or two years together in the same pit, but when we see an occasion we enforce the use of it.

2780. You say the work is let to men?—Yes.

2781. Do you consider yourself still responsible for the safety of those men?—Certainly we do; and I have a bailiff under me that goes regularly and daily into the pits, whose whole work is to go down into the pits and see that the work is all gone on with in the regular way.

2782. If he were to order any given number of men to put out their candles and light the lamps, would they obey him?—No doubt they would. The masters would have that much power with the men; the charter men are generally men of influence, and men that have had a great deal of practice in mines; we generally pick the best men, and those men, if they saw danger, would stop the men from going into it, and the men no doubt would obey them.

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2783. Does the bailiff regularly examine the state of the air in the pits?—Yes, he does every day, in one pit or other. My bailiff comes to me every night when I am at home, never misses a night, and everything is talked over every night as what is to be done the next morning.

2784. Does he report the state of the ventilation and everything relating to the working of the pits?—Every day regularly; he comes every night.

2785. Do you consider the method of working the mine, as described by this plan, to be favourable or unfavourable to ventilation?—It is the best mode I know of, of ventilating that mine.

2786. More favourable than other methods you have adopted?—If we were to work it long work, it is so thick a mine that it could not be worked with safety, though the long way mode of working a mine is the easiest and best mode of working a mine. We work all the other mines long work and do not leave any ribs at all; we have always the air at the face of the work, it is always going past the men that are working. But in a thick mine like that we could not adopt that course.

2787. And the space that is left behind, how do you enclose it?—It keeps coming in behind, we let it come in as close as it will, the closer the better for pinning it up.

2788. How do you manage to keep it close?—It will come in very close, sometimes too close; in a general way, we have what is called heavy roofs.

2789. What do you mean by heavy roofs?—That is a heavy top, marly, not a rocky top.

2790. And that falls very solid in the waste?—That falls down into the waste and fills up the space; we make pinnings with it in the waste every three or four yards all the way up, so as to keep it full of carbonic acid as much as we can, and to carry on the workings.

2791. That is, you keep throwing up the refuse behind you?—Yes, the pinnings, so as to support the face of the work.

2792. Do you consider it is in the power of the Legislature to impose any rules or regulations on the miner, which would not be found both by masters and men to be a great grievance?—I think it would be a very great grievance to do so. I do not see that it is possible.

2793. You spoke of the union; is it one of the objects of the union among the colliers to prevent the use of the lamp?—No, I do not think it is. I have no doubt the union generally is not so much known of in the collieries as it is in the Potteries, although it is well known they are supporting the potters regularly every week.

2794. That is, it is an object of both parties to increase their wages?—No doubt they are supporting each other.

2795. But it is no part of their plan to prevent the colliers from using the lamp?—None whatever.

2796. You have said that 10*s.* a week was a reasonable compensation for the difference in working this great Row Seam, as between lamps and candles; would the same remark hold good as regards the other seams which you are working?—It would; but we have very seldom any occasion to use it in the other pits. The air is always running close by the men, and therefore we use it very seldom in other parts of the work, except it is to thirl for air or some little particular job.

2797. Do you conceive, as a practical man, that a six-foot seam might be worked very conveniently with a lamp, when a ten-foot seam might expose the parties to great difficulty?—Yes, it might; because they would not have a roofing to do that which we have in the ten-foot seam.

2798. Then you consider that your case is one peculiarly disadvantageous for the use of a lamp?—Yes, it is in the roofing; and also the dip of the mines is an objection to the use of the lamp.

2799. What lamp have you been in the habit of using?—Davy's.

2800. What provision have you in that neighbourhood for the men in case of accidents?—There is no particular provision except the clubs that are about the neighbourhood; there are a great many sick clubs; we have no field club. In cases of accident I give their families something till they get better again; at the time of the last accident I gave the widows and families money, when I thought proper, five or six times.

2801. Do you consider the workmen generally sufficiently intelligent to leave a place of danger in the absence of the bailiff or the charter-master?—I do; some of them

them from practice, not from education; they are a very uneducated part of the community are the colliers in our neighbourhood.

2802. Do you consider it any part of your duty, either annually or at other times, to give the workmen in your employ any general charges as to their personal safety?—We caution them continually, regularly weekly and daily, in case of danger; we are very particular in giving them caution.

2803. Have you any printed rules or regulations or instructions?—No, we have not.

2804. Do not you think it would be expedient to place a printed list with a few simple rules of instruction in their hands?—I think proper instructions of that sort could do no harm.

2805. They get those instructions, I take for granted, from the agents in general verbally?—Verbally, as most of them are men that could not read; and if printed notices were stuck up, they would have to be told verbally, most of them, one from the other, though I think it would be of some service.

2806. And placard them in different conspicuous places about the works?—They might be of some use in that way. At any rate it would prevent prejudice from operating against their employers.

2807. Are their children generally taught to read in day schools or Sunday schools?—They are in both, and in the Potteries now greatly improved in that respect.

2808. The boys are employed down the mines?—There are not many boys in the Potteries employed in the mines; they generally take them to the pots or potteries, viz. their children, and a great many colliers go to the pot-works likewise; if we had not a constant succession coming from other collieries, from Newcastle and Shropshire, and the southern part of Staffordshire, we should be always short of colliers.

2809. The wages of potters are generally superior to that of colliers?—Very much.

2810. And the wages of colliers, too, in that district are larger than in other parts of the country?—They are. I conceive no part of the county of Stafford are giving so much as 4*s.* 4*d.* a day, besides just in our own neighbourhood.

2811. You have said that your mines are rendered very dry by having such a large dip, the mines drain so completely; your workmen do not suffer from wearing wet clothes, then, I presume?—No, they do not, except in driving the bottom levels; when they first start it is wet.

2812. Do they change immediately on coming to bank?—Yes; and they do not work more than eight hours in a day in wet work.

2813. Do they change their dress on coming to bank?—They do; in levels and sinking they generally work eight hours shifts; four hours off and four on. They change their clothes every four hours.

2814. What number of persons under 18 or 21 years of age do you think you employ; what proportion?—I should think we have not a sixth of the whole.

2815. How long do they work?—Ten hours and a half a day, from six in the morning till six at night, having an hour and a half out for dinner and breakfast.

2816. Have you visited any of the adjacent mining districts of Wales or Lancashire?—No; I visited a mine in Derbyshire, belonging to Mr. Gisborne, the Member of Parliament for North Derbyshire, some time ago.

2817. Did that seem an explosive mine?—Not at all.

2818. Near to Stockport, is it not?—It is not a long way from Stockport; I went to Stockport to get to it. It is a very well conducted place is that; they are getting a good deal of coal out of it, if it were but good coal; but it is a very inferior coal.

2819. You are now working ironstone mines?—Yes.

2820. Have you frequent accidents in those mines?—We have had some accident in them, have had a man hurt a little, but no man killed.

2821. At what depth are the ironstone mines with you?—From 20 yards to 200, amongst the regular strata of coal, &c.

2822. Now, you are quite aware of the objects of this inquiry; does anything strike you to name to the Committee, interesting to the welfare or safety of the mine population of your district?—No, nothing particular strikes me. I do not see that anything can be improved by way of ventilating the mines, except some plan could be devised for absorbing or condensing the gas as it comes from the mine, by some chemical process.

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2823. Do you allude to any system by which the gas could be effectually neutralized or at once absorbed?—Yes, condensed or absorbed. I do not see anything better in ventilation, except something of that sort can be done. I doubt whether we can ventilate in a better way.

Mr. *James Ryan*, called in; and Examined.

Mr. *James Ryan*.

2824. WHERE is your residence?—Middle-town Hill, Montgomeryshire.

2825. What is your profession?—Director of mines.

2826. In the course of your professional engagements, have you become acquainted with the mines of South Wales?—No.

2827. Do you know anything of the mines in North Wales?—Yes.

2828. Has your attention been particularly turned to the best mode of ventilating coal mines?—I was employed by Sir Thomas Mostyn many years ago, for to view his mines; and also by Mr. Roscoe. I was employed by Rigby and Hancock, in 1804.

2829. That was about Flint and Bagilt?—Not far from Bagilt; the name of the place, Llanwarder Colliery.

2830. Then, in point of fact, you have been a mineral surveyor for a long period of years?—I have been a mineral surveyor since 1800. I was under the Grand Canal Company, in Ireland, in 1800, as a mineral surveyor; my name stands on the books of the Dublin Society for 1804, the Dublin Society's Transactions. General Vallancey was then president, and Richard Kirwan mineralogist, who stated in that year to me, as a director of mines, that I was deserving of public encouragement.

2831. Then perhaps you will be able to state to what extent the public have given you encouragement?—As I mentioned, I was employed by Sir Thomas Mostyn. I looked over his colliery, and I gave my opinion. I lay it down as an axiom, that where there is no dislocation of the strata, there can be no confined carburetted hydrogen; and where there is a dislocation of the strata, I say, remove the cause and the effect ceases. In my lectures upon ventilation I have generally referred to something in print, or something like unto print, so that the public might understand what I was speaking about, as the public is not in the habit of going under ground. I take this newspaper for my model: I will suppose the type to represent the coal backs, as smooth clearages, that act as tubes to transmit the gas from the irregular fractures, called cutters, to the surface, if uninterrupted by faults or dislocations. The type represents the coal. I calculate that three parts out of four of the collieries of England are free from gas; all the rise of the Mostyn colliery, and that of Bagilt, are free.

2832. Did you perform any experiments, or make any change in the ventilation of Sir Thomas Mostyn's mines?—No; I gave an opinion upon it, and left it. I was employed by his agent, Mr. Jones; consequently, I gave an opinion, and they might perhaps put it into effect; but it was not put into effect by me. Mr. Watson, of the Tyne, I understood was employed afterwards.

2833. Then did you visit the north of England after that?—I did.

2834. Now did you perform any experiments on any of the mines there?—No. I went to Newcastle; I saw Mr. Brandling, and proposed to Mr. Brandling a plan for clearing the mines from inflammable gas, by cutting a drift, or what they call in the north a board, along the lower side of the fault, down as well as up through dislocations. Mr. Brandling referred me to Mr. Buddle; I had a good deal of conversation with Mr. Buddle upon the plans. Mr. Buddle said that they had very few losses of life; and on reference to the Newcastle local records, I found they had very few losses indeed; on an average of the preceding 50 years, not a life in 10 years. I saw their blowers proceeding from the backs, which was very trivial indeed; yet such as might be expected from a six-foot seam of coal.

2835. Are you alluding to Mr. Brandling's mines, or to the mines of that district?—To the mines of that district.

2836. In what date was this?—In May 1806.

2837. Do you mean to say that in the local records there was only a proof of one death by explosion in the course of 10 years; was that the average?—In an average of 50 years there was not one in 10. I believe the local records will prove that. I speak from memory, not having the work alluded to. I admitted that fact; and Mr. Buddle then told me he was taking steps to do away with explosion altogether. If the local records are produced, I think I can show that.

2838. Now

2838. Now, in consequence of this conversation, did you give any lectures upon the subject?—I did.

2839. And were you called upon to try the experiment upon any particular mine?—Not at that time, not in 1806; I was afterwards.

2840. Well now, where was your first experiment performed?—Within a mile of Dudley.

2841. In what year was that?—In 1808.

2842. Do you remember the name of the mine?—Netherton.

2843. Do you recollect the depth of the shaft?—Seventy-five yards, I think.

2844. And the thickness of the seam?—Ten yards.

2845. Now, was the complaint of a bad ventilation in that mine, the infusion of gas, or the want of air for the workmen?—That mine was upon the diluting principle; that is, upon the principle laid down in Mr. Buddle's work.

2846. You allude to his letter to Sir Ralph Milbank?—Yes.

2847. Did you find it necessary to make any change in furtherance of your own views?—Yes.

2848. Were you successful in that change?—I will endeavour to establish that I was.

2849. Can you state to the Committee what you did at that mine?—I can. I have a certificate to that effect, that I think I have got with me. I cleared that mine, by the labour of two men and two lads, in 20 days' work. I was employed by Lord Dudley and Ward.

2850. You are speaking of the Netherton mine?—The Netherton No. 16 pits were in the regular habit and practice of being fired by a fire line, from the year 1798; that is, after they had done all that they could in point of diluting or mixing the gas, the redundant quantities had to be fired in the morning at four o'clock, in the middle of the day at twelve, and in the evening at seven; after all was done by diluting and ventilating that was possible, the mine had to be fired three times a day. I employed James Skidmer and Thomas Cook, and two sons of James Skidmer, colliers, to work for me. I wanted very much for Lord Dudley to first allow me to begin my experiment upon a six or a ten feet coal, such a coal as I could reach with my hand, and I told the agents that, and they objected to it, and said I must either take that particular mine or have none. I commenced operations on 3d December 1808, and on the 27th of that month I declared that mine fit for the reception of men, and that no man could burn himself in that mine without a good deal of labour, that is, without cutting into the gas course. I have a door on the gas course, where no man can get in; all the rest of the work he can go through. I will now show the certificate, that is signed by a gentleman who is present.

[*The same was handed in.*]

2851. This certificate purports to be signed by Samuel Fereday, Richard Smith, and Charles Norton; and it states that they have witnessed the experiments which you made for the purpose of destroying the inflammable gas contained in Netherton colliery, and that the subscribers are of opinion that it answered the fullest extent of the purpose for which it was intended; and that by a small portion of the means you had to effect it, the gas-head was contracted from nine foot area to that of two inches area. You wish to put it in as the certificate you received on that occasion?—Yes.

2852. Now will you state by what mechanical means this was accomplished?—I have not a plan of the mine.

2853. Give us a verbal description, if you can?—The collieries of Dudley and that neighbourhood are worked in squares; the roof is supported by pillars. There were air-heads carried in at the bottom of the coal, the middle of the coal, and the top of the coal, by which air was blown from the downcast shaft into the works, in order for to expel the gas, or by mixing with the gas to blow out the gas, on the system of the north. All that I did in that case was to run across the backs clearages of the coal; I found that their heading was air heading; I transformed a part into gas-heads, which were to contain gas instead of air. When that was drawn off, next comes the riper air from the horses, &c., then cold air, and the regular feed of hydrogen thrown off, which must flow with a velocity equivalent to its quantity. I merely employed those men that I have mentioned to cut across the backs of the coals, that is, separating the type line from this fault, which I represent by the leaded line that separates the columns of a newspaper.

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2854. Separating one portion of the mine from the other, that is?—Separating the ends of the coal, as coal has a particular crystallization. This is the end of the coal, in allusion alone to its face; this is the face of the coal [*pointing to a piece of coal*]; the collier works on the face generally. This is where the gas is generated in those clearages, at a low temperature, that does not throw off sulphur, yet the process is similar to gas works. I propose to light the works, towns, &c. by the gas, which is pure as taken from the mine by gasometers; and my opinion is, that there would be no gas only for the stoppage of those springs by the faults, &c. This red line here on this raised matter represents the gas-head. All that I do in that case is to cut off a piece of this end of the coal; I run a board along the fault, in which case I throw in a body of air of one, two or three atmospheres, pump it in or blow it in by bellows, to keep the gas back from my men while they are driving this gas course. Here are the two pits of No. 18; the pits were first ordered to be sunk in the most fiery ground that Lord Dudley and Ward's agents could point out. I got those pits sunk; and under my direction I drove out a line of above 200 or 300 yards westward, or with the face of the coal; I drove this upon the end of the coal, from this pit to this place, 300 or 400 yards, I think it was; it is so many years ago that it is almost out of my recollection. I then turned north and south; I believe I drove about 400 yards here in one line. I went from this gas-head to that; I worked out this quantity of coal on dip. Instead of wood pipes I used iron, as it appeared to me more handy, but neither has any part in my system; it is a temporary expedient, which ceases as soon as the drift is made. While he was cutting this drift to the extent that I wished him to go, he had pipes to receive any gas that could immediately arise in working in the confined space that he was in, which was three feet wide and about six feet high. That was to go into this. There was no gas interrupted us whilst on the end of the coal. I had but one face in the space I was in. When I came here, the gas then began to pour out in very large quantities from the blowers that we met here in the gate-road or horse-road or rail-road. I then ordered that the gas-head should go in advance of the gate-road or horse-road, to cut the blowers as they went along. We wrought in the dark, or by Cantoon's phosphorus, which I had taken to-day, that they might absorb the light of the day; I got the cases from Allen & Howard, and they were brought in occasionally for to give a little light, which we supposed it did. I had no lamp in the place at that time. The men worked alone in the new pits, No. 18, which I kept from explosion; but the men in No. 16 pits worked from the 3d to the 27th of December, in all 20 days' labour; then the works stood to accumulate gas till the 1st of January 1809, to try, that is, to allow it four days to fill with gas, when about 40 gentlemen descended. That Gentleman was one [*pointing to a Gentleman present*]; and there it is recorded. I got a close stopping to put into a gas-head that I had made, that was nine feet; I contracted that into an area of two inches, in order to show the quantity of gas that particular mine generated, when they pronounced that it was free by a small portion of the means that I had to effect it. This is the quantity of gas alone that I had then to contend with, that was immediately generating in the open works—these two inches; but the gas was taken off in the backs; that did not at all come out there; but these two inches were more than adequate, as is certified by this certificate.

2855-6. Do you know if that colliery is in a working condition now?—I have heard that it is worked out, and never had an explosion.

2857. Now what was the next mine that you attempted?—The next trial that I made was upon No. 18. There were 18 pits in Netherton colliery, and these were two of the pits. This No. 18, I have to remark, that Mr. Buddle was down in this pit, and examined it, and was good enough to say that it was free from fire except in the gas-head. Now had the pit No. 16 have stood for twelve hours prior to my taking it in hand, it would have burnt all the men that could have stood within its dimensions, which were pretty large; it would have burnt them all to a cinder.—[*See* second Certificate.]

2858. What was the quantity of ground excavated in that colliery, do you suppose, in the area, to 1808, when you went down, speaking in acres?—Probably eight or ten that were excavated; I do not know; perhaps more. The collieries are closed up as they go on. I was in it only a month.

2859. They close them up by damming the bolt-holes horse-way into the square work?—Yes.

2860. Were you equally successful at No. 18?—The certificate No. 2 will speak

speak to that. An objection was raised in No. 18. Having kept No. 18 free from fire, Lord Dudley's cashier, Mr. Downing, had given it as an opinion, that if I were not there, there would have been no fire in No. 18; yet No. 18 had fired. When I got to the bottom of the new pits, I sunk these two shafts; the men had ceased till I came back from some business I was on, in the line of my profession. When the pits were sinking, I ordered that no air-head or no gas-head of any kind should be driven till I came. The men were then put out until I did come, by fire. Mr. Downing made an assertion to Lord Dudley, (the late Lord Dudley and Ward,) that there was no fire in the ground. I then requested Lord Dudley for to let me remove my system, and to put the old system into effect. He did so; and we let the pit then stand for about two days. Lord Dudley's agents were then ordered for to go down to inspect the work; I cautioned them to take care to go down in the dark, and not to bring candles down with them; that I thought they would find the works fiery. They went down, and reported the works very dangerous; very fiery. And then, what was an extraordinary thing, Mr. Downing challenged me for to clear the works myself again. I then offered to clear them in six hours. I do not call that clearing, when it is clear to-day and will be full to-morrow; I do not call that any ventilating; I call that worse than not clearing it at all. This was the certificate that I got [*handing it in.*]

2861. This certificate, No. 2, alludes to certain experiments which have already been described by you in your evidence, does it not?—I think I did not give in this before.

2862. It is signed by the Hon. Washington Shirley and Samuel Fereday?—Yes.

2863. And it states, "We have no hesitation in saying, that during a course of experiments for two years and a half, in the most dangerous works, without firing line, or any other expensive precaution, he (Mr. Ryan) did not lose one life, neither was any one rendered incapable of labour; and the effects of his operations are still visible and evident in the works." That is the certificate to which you allude?—It is.

2864. It is dated April 26th, 1811?—Yes.

2865. Well now, is this the system that you have adopted in all the other collieries that you have had charge of?—I have only one system, and that is merely for to run a drift along the faults or dislocations of the strata, and drain them. In fact, it is merely drawing off the gas, and taking it out of the way of the men; for I conceive that as long as the gas must travel in the same place with the men, so long there must be calamities.

2866. Now, have you tried this plan in any mines where the thickness of the coal did not exceed five or six feet?—Yes.

2867. Will you give the Committee a case in point?—In Deep Field colliery.

2868. Where is Deep Field colliery?—Near Bilston.

2869. Does that belong to Lord Dudley?—It belongs to Mr. Fereday.

2870. Did you adopt the same plan there?—The same plan.

2871. And was it attended with the like success?—Yes, it was. I have no certificate to speak to that; but I believe it was. I never heard to the contrary.

2872. You have reason to believe that the party who employed you was well satisfied with your operation?—Yes, Mr. Fereday. I never heard him say otherwise. I have got no particular certificate with regard to that; I did not think it necessary; for if I could clear a 30 foot, I could a seven foot. I only give a few cases which were done under trying circumstances. When I was going on with those trials all the mines in the country were copying from me. I have no secret in such a case.

2873. Now you are aware that the system in the north of England, although not altered in principle, has been considerably improved in practice by what is called dividing the air course, since the period to which you allude?—I conceive, since the period to which I allude, that the practice in the north of England has been rendered most destructive by the operation, which I will endeavour for to prove to those gentlemen, and to show the cause: action and re-action are opposite and contrary, and must be so. The persons who had the means for to practise the most powerfully, those persons have had the greatest quantity of explosions; and whoever acts so must always have. I have only to mention a case, one which I think necessary to show inattention to number and quantity. At page 22 Mr. Buddle says, "the standard air-course or current of atmospheric air which I employ on ventilating collieries, moves through an aperture of from 30 to 40 feet area, with

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a velocity of three feet per second, or 700 hogsheads per minute. This standard of ventilation I conceive to be equal to dilute and render perfectly harmless a stream of gas issuing at any rate between 170 and 230 hogsheads per minute." This is little more than three of air to one of gas. May not this account for every disaster? Then he says, "on the strength of my own experience in collieries thus circumstanced, I freely hazard my opinion, that any further application of mechanical agency towards preventing explosions in coal mines would be ineffectual," &c. What would we think of a medical boy that would use such an expression?

2874. Are you not aware that in all difficult cases it is usual to call in the man that is esteemed the most clever?—Certainly.

2875. Does that not hold good with medicine, surgery, and other professional occupations?—It does, certainly.

2876. And therefore, if the cleverest man should have had the lamentable fate to have the most accidents, it may be accounted for by his having the most difficult work to undertake, may it not?—Certainly, I will grant that far; but in the case that I allude to, I believe I can show that it is the system that has caused the explosion. The very pit I am now alluding to, a Mr. Barnes from the Tyne was brought by Lord Dudley; he went down into No. 16, the pit that I alluded to, as certified by Mr. Smith; he made his observations and report to Lord Dudley, saying, "There is no work in the north, my Lord, that I cannot clear and keep clear for one, two or three years; but certainly this work I cannot keep clear for 12 hours, and I would rather have nothing to do with it." It has been related to me by several, that Mr. Barnes made such an assertion to Lord Dudley; and Mr. Buddle has told me that he was considered as eminent a viewer as any in the north at that time.

2877. That was about the year 1809?—No, it was about the year 1800. Mr. Barnes was there about the year 1800; he was there before me some years.

2878. Now did you ever descend any of the mines in the neighbourhood of Newcastle?—I did.

2879. Did you ever descend Wallsend colliery?—No.

2880. What is the most recent work of this kind you have undertaken?—The most recent work is at Mostyn; by giving an opinion. I am not now so immediately in the line; I have a mine of my own, called Middle-town Hill mine, and I do not go to stay, as I formerly was in the habit of doing, and superintending works of this kind. I gave merely an opinon to the Mr. Etons, who are now working the Mostyn colliery. I have made a report to that effect to them. With regard to the mine carried on at Mostyn, it was reported to Sir Thomas Mostyn, many years ago, that if he would adopt the Newcastle method he would make a very large return. They carried out but 1,500 yards upon that plan; and the loss of life and property became so great, that the viewer (Mr. Watson) said, "Sir Thomas, I can go no further, for the gas is so very powerful." He gave up the mine as a dead loss, although the coal was his own. That work has been again opened by Thomas Lewis, who has got many thousand tons of coal, yet does not know a word of English; and without loss of life, limb or property. This speaks much. The Hon. L. Mostyn can speak to this fact, which is worthy of record; it is systems and bad measures that should be avoided, such as are at variance with nature. I am now speaking without book; but I believe I can be borne out by the proprietors of that mine, by the Mr. Etons.

2881. Can you furnish the Committee with any data as to the loss of life in that colliery, at any given period?—There were in 1806, I think, 36 lives lost; I cannot say more. There were a great number of lives lost, 36 in one explosion that happened in 1806, and I believe about 30 again in another; and then I think Mr. Watson gave that up.

2882. Are those mines now working?—The mines are now working by the Mr. Etons.

2883. Are they working on your system of ventilation?—I gave an opinion to them. I do not know whether they are adopting my system. I believe Mr. Edward Eton approved of the system; he is a scientific man.

2884. Do you conceive there has been much loss of life in those mines recently?—No; very few lost latterly.

2885. Now will you state what you consider the difficulties in the most improved mode of ventilation which you are aware has been in practice in the north of England?—I was called to the Tyne in 1815, by the Society for the preventing of Accidents in Coal Mines.

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2886. Did you undertake to drain any mines in that neighbourhood of gas?—I did.

2887. What mine did you undertake?—Heaton. I was called before a number of gentlemen at Newcastle-upon-Tyne; the names were Dr. Gray, Mr. Turner, J. H. Brigg, — Winch, J. Carr, John Jodgson, C. Benson, Wm. Clark, Wm. Armstrong, D. Brown, Wm. Brandling, and Anthony Clapham.

2888. That was the committee of the society, then in existence, for encouraging scientific men to turn their attention to the best mode of ventilating mines?—No, this was a distinct thing. Those gentlemen were particularly chosen for that, as men eminent in philosophical experiments.

2889. Now this certificate states they approve of the principle of your ventilation, and recommend it to be tried?—Yes; they thought attempting a vacuum, and shutting out the gas from the men, valuable; this, and crossing the face of the coal, is all my system. Then Mr. Buddle says, "Mr. Ryan, there is a work which is too many for me, which if you clear, I pledge myself for all the viewers on the Tyne and Wear, they shall acknowledge the superiority of your system." I said, "Mr. Buddle, I don't know the work you allude to, but let the merits or demerits of my system rest upon that trial alone. I am ready to go on with it." I then ordered a foreman of mine for to come on, and the matter was then taken up by the coal trade. This is the certificate. [*Handing it in.*]

2890. What year was that?—The year 1815.

2891. In answer to the queries then proposed to you, you said you would expect to receive the sum of 5,000 *l.* for your discovery?—That was mentioned to me by Mr. Grimshaw, that if I succeeded I would get from 5,000 *l.* to 10,000 *l.* I said, "Gentlemen, I don't want any money at all. That is not my object; my object is to save life if I can."

2892. Now did you try Heaton colliery?—I did not; that is, I was not suffered. I asked a month for to do it; Mr. Buddle said that the pit could not be spared so long; he then came to say, that the men would not work in the pit when I was in it, and he could not hold himself accountable for the men abusing me. I said I would take the chance of that. I went down with Mr. Buddle, who showed me the mine and a few blowers, such as flow from thin seams of coal, but of no moment.

2893. Then from prejudice or some other cause you were prevented trying the experiment on Heaton?—I then asked a fortnight to clear the Heaton mine; he said that was too long. I then asked to go down on the Saturday at 12 o'clock, and I would come up on the Tuesday, and let the merits of my system rest upon that; and I think I can prove to you, gentlemen, I could have succeeded in clearing it in that time. I would have simply reversed Mr. Buddle's method of working, which any man of science will perceive will account for all that has occurred in the north; I only wonder at there being so few deaths from the means employed. (See Letter to Sir R. Milbank.)

2894. Is the Heaton colliery worked as a colliery now?—I do not know.

2895. Do you know whether it was since 1815?—It was in 1827; I was there.

2896. That was 12 years afterwards?—Yes, but it was then full of fire; it was then worked by lamps, all lamps; and all Wallsend, as I understood.

2897. Now can you give us any reasonable exemplification of the practical use of your system within the last five years?—Yes, all the mines in South Staffordshire generally. I gave you the Mostyn colliery. If Mr. Hawkes were here he could speak to this fact: Here is Mr. Hawkes's estate [*pointing to the sketch*]; here is Lord Dudley's [*pointing to the sketch*]. Lord Dudley's had fired from time immemorial; Mr. Hawkes's had never fired upon any account. I can see no reason or no difference between the seam of coal thrown down here for 150 yards, and the seam of coal here; I could see nothing in it only this fault, and I saw no particular charm in this fault that could cause fire in that place more than this; and if I made an opening in this place here, cut off a portion of this, and let the gas flow into this, and draw it and connect it with this pit, I must say I think I stand at least in a better form than nature, when nature throws the gas into the atmosphere. At the Wigan coal-field I can go along the surface for 10 miles; I can fire the gas in those 10 miles, called burning wells, yet in the ground that is working under that there is no fire; while in Mr. Hasley's and Mr. Clark's mine, immediately below the fault, there has been destruction, and in other mines, the mines below the fault. Now I can see nothing in that fault, I see no charm that would cause gas; what I therefore say is, when these faults occur, they merely act as dams for their whole length, and the

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ends of the coal that lies against them should be separated by making a road along; simply make a passage for the gas, and when you can once get in a portion of the gas another portion will come in, in proportion as you rarify, and the gas will flow then in greater quantities; and in my way I draw off the gas entirely just here, then mixed with air, &c.; when the gas is pure the travel is in proportion to the levity of the gas. No man is suffered to go into the gas-head; I never found the colliers were anxious to destroy themselves; I never could perceive it. But it is not only that, but I will go to any mine, and can clear any one in Britain in the same way. There is no fear attending this.

2898 What is the depth of that mine of Mr. Hawkes's?—One hundred yards.

2899. And what is the depth of the other?—It is not drawn to a scale; it was done in a hurry.

2900. About what?—About 125, I think.

2901. The deeper a mine is the more liable it is to be filled with inflammable gas, it it not?—I never knew that; for at Bath, the deepest mines in England, they have no gas belonging to them at all; they are 400 yards deep. The fiery mines of Staffordshire seldom exceed 100 yards.

2902. But is not that the fact as regards the Staffordshire collieries?—I never knew that.

2903. Are you aware that it is the fact with regard to the collieries in the North?—I never understood so.

2904. Is this seam and that the same?—Yes.

2905. Then this is thrown down by the fault?—This is thrown down by the fault.

2906. Are you not aware that there are many very extensive coal fields in the North, in which there are no such faults?—There are faults; the 90-fathom dyke is the great governing principle; all above that, as far as I could examine, is generally free from gas; the coal is worked there without any danger, they have only to look to the water.

2907. Are you not aware that there are gas fiery mines on both sides of the dyke?—There are some little partial spots, but very few; for I have examined it carefully. I could find in one place about 10 acres governed by that small locality.

2908. You have not been there within this last five or six years?—No.

2909. Since the mines were sunk to a great extent on the deep side of the dyke?—Mr. Brandling was then sinking a pit at Gosport, he was beat out by water on the raise, but they met no fire. He then removed to the deep of the fault, in which he met with little water; on the deep of the fault he had no water, but he had a vast quantity of gas.

2910. Can you explain why this mine was subject to inflammable gas, and why the shallower mine was not?—Because that the fault dammed down the gas, as water is dammed up.

2911. What did the fault consist of; rock?—Of earthy measures; common metals of mines.

2912. What are the measures found in that fault?—All the general measures.

2913. But it consisted in a great degree of rock, did it not?—A good deal; it was an impervious fault; a good dam.

2914. Impervious to water was it?—Impervious to water and impervious to gas; for where the one descends the other can ascend.

2915. Then do you consider it was the absence of the water on this side which occasioned the fire-damp?—What will not let through water, will not let through gas. It is not the fault that makes the gas, it only stops it.

2916. Can you explain to the Committee by what means you get quit of the inflammable air?—By simply cutting a drift along the fault, as often as the fault occurs. I will now go to the Foley fault, at Lane End. I will cut along that Foley fault, and separate the backs from it; I will separate the pieces of the ends of coal from the fault, leaving the backs open where the drifts are; those roads driving out as they cut a blower in the road. I would say, if the gas course above, or at a mile or two miles distant, did not cut that blower off, taking the ends of it, if it did not cut off the blower, I would then consider there was some additional fault that had come in between that. For instance, some blowers will yield 700 or 800 barrels of gas per minute. In proportion to the extent or quantity that the blower discharges, I conceive that the extent of the fault may be measured; that the effect of the fault should be further removed; for when the faults come in very close together, the blowers will then yield but very little gas; they

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they have not space to work upon; the tube is so much shorter. Where there is a long tube there will be a great deal of generation of gas; and I am of opinion the thing is much cheaper than the old plan, even if it succeeded; and coal will be got in double quantity. The board and headway system takes 17, I do with 10. It makes twice as much slack. Risk of life is none; because the men that go in to cut this gas course they are protected; they may so far breathe out of a bag of air; they may have a bag round them, and breathe out of it while they are cutting that gas course. I have had men certainly very nearly suffocated; but still I gave them a quantity of air in a bladder to enable them to make their retreat until that blower would be drawn off in some quantities, which a day will effect.

2917. Then your mode of taking off the gas is something upon the principle of drainage, as applied to land?—Exactly. As I mentioned at first, it appeared to me, from a patent that I had for draining land and draining mines, or bringing up part of the coal or strata of the earth, that I found when I was far from a fault, or when there was no fault behind me, the quantity of water was immense that was raised. In some places where I bored I found there was no water; go down what depth I would no water would come. It was that at first led me to the idea that mines might be drained on the same principle. No matter whose system, if men and gas travel together, there must be calamities.

2918. Can you mention any collieries in which your principle is now pursued?—All Lord Dudley's; Buffrey colliery, and all in the south of Staffordshire, I believe it is generally adopted. At least I understand so. A committee went from the Tyne, consisting of John B——, Geo. P——, and John H——. I wish to correct a matter that appears in Mr. Buddle's evidence: I was not paid 5 *l.* or five guineas a-week; I got 40 *l.* till the committee would come back again from Dudley. In a week they returned from Dudley, and said my system was attended with terrible destruction, and loss of life and property, and that I completely failed. Mr. Buddle is wrong. I do declare I never lost man or horse by any operation in mining in all my life. The letters that I had sent to Mr. Fereday and Mr. Richard Smith, Birmingham Philosophical Society, and others, were brought back to me: these gentlemen could not be found, yet all at home. I called again after that on the coalmasters of Dudley, who gave me that certificate. I have another from the clergy and magistrates as to character, which Mr. Buddle attacked; but I refrain from giving it, it is too mean.

2919. This was in 1818?—Yes.

2920. Have you been called upon of late years to apply your system to any particular mines; within the last five years?—Yes, about two years ago, the Mostyn colliery; but I do not generally make a profession of it now; I did formerly live by it, and I made a good living by it.

2921. Then in 1810 you had a certificate of the value of your system, under the hands of Mr. Shirley, Mr. Fereday and others?—Yes.

2922. That was before the discovery of the Davy-lamp?—Yes.

2923. And again in 1818 you had a further certificate of the value of your system, under the hands of a considerable number of coalmasters and ironmasters in the neighbourhood of Dudley?—Yes; and those men now will state the fact how the operations are going on. I have to mention I had also, not the written certificate of Sir Humphrey Davy in 1810, but afterwards, when I lectured at the Royal Institution in this town, Sir Humphrey Davy was pleased to say: "Gentlemen, so clear has Ryan's system appeared to me, that I consider all lives lost in future by fire-damp to be a profligate waste." I think those were the words he used; there were a number of gentlemen present at the time, who will recollect Sir Humphrey saying so at the Royal Institution in this town. I was then showing the nature of drawing up the fire-line, and what I did in Staffordshire, explaining the nature of faults, &c. through that medium. I have people for to prove, if they were got up from Staffordshire. There is one man in the Potteries of the name of Joseph Harmer; he fired No. 16 pits for 18 months prior to my taking it in hand; it cost Lord Dudley 75 *l.* for the firing alone, without talking of the loss of coal. As long as the fire-damp and the men travel together, so long one circumstance or another must cause destruction. The other is cheaper. I do not care what way you work a colliery; when it is once ventilated, then begin and work it. I have drawn a drift in the manner here represented.

2924. How long to your knowledge has your principle been in practice in any particular colliery?—Since 1808.

2925. To the present time?—To last week.

2926. Have

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2926. Have you seen that colliery within a short period?—I did not go down it, but it is free, I understand; but there are a thousand pits on my system, although not by my hands; any one can do it; it is simple. Mr. Smith has been down; last week returned from there. Lord Dudley and Ward refused to fulfil a promise made me, because that any of his agents could copy my plan, as so simple in its principle; yet some have done it an evil; they have drove the drifts in a wrong situation, and too low in the measures. If the Committee wish to go into the matter, and to summons three or four men from that country, I would show a very plain simple system of ventilation, in which there is no necessity for the loss of life, by which they could get more coals, and would get them safe; you could then lay it down as a principle. Gentlemen of one mine in the north congratulating the other on its being free from fire, yet in three or four hours after there is a terrible explosion. It was the case at Wallsend; that was the case at the Felling colliery. In the evidence before the inquest, one viewer goes down and congratulates the other, and three hours afterwards there is an explosion, and 101 lives lost. Does not this show an ignorance of danger? Gas, although gas does not appear, is still generating in the coal. A whimsey lad is charged with manslaughter for drawing a man over the pulley, yet the viewer will let a mine of a mile near fill, and not know it.

2927. Then you consider that where your principle is pursued there can be no such accumulation of gas as to cause an explosion?—It is impossible; no more than the drains in the field. If I make those drains of sufficient strength; I must take care and make these gas-courses of sufficient firmness and durability; but even if it does fall in, it cannot fall in so close as not to take off some of the gas. I will admit that if it falls in, that will not prevent it from still ventilating the mines. The difficulty is in the driving off those passages, but when they are once driven they will be as permanent at least as well-drained land. I never knew of a gas-course falling; I would not suffer it to fall; but I have latterly people who can do it as well as myself: Mr. Grainger can do it, Mr. P. Smith, and many others. There is no necessity for me to go into the matter; if you want to have the matter done, it is not alone for me to do it; any man can clear the mines upon my system. If a man goes into a gas-head with a candle or an open flame, he will suffer death; but there is no necessity for any person going in, as you see. The matter is very plain: I will suppose this to be the fault, and this is Mr. Hawkes's fault, it is adjoining this; all I have to do is to run along one mile or ten miles, and then put a draught upon this pit. I make along this fault; I cut out a piece; I run alongside of this fault for any length, and I drain it all. A. or B. has a colliery here of a mile long; call this a mile square; I run along till I cut the last blower, that is, a blower at this place here, and I do not cut it here, but run along further; so that, supposing your property lays here, a request is made for to let me go a few yards further, in order to cut off the blower that is here; and there I have this in my opinion free. These white lines are the conveyances of the gas to flow into this gas-head.

2928. And you consider that those conveyances exist in every stratum of coal?—Yes, and the nature of the coal will show it; it has a horizontal and perpendicular clearage.

2929. Are you not aware that the most recent plan of ventilating fiery collieries in the north, is to keep what is called the gas or foul-air drift entirely separate, distinct and remote from the free or pure air-course?—That is my plan; that is, the plan that I lay down is to bring the gas by any means, it is not material what, and I say the best way is to run across the natural backs of the coal.

2930. But where there are no such natural backs or crevices, your simple object will be circumscribing certain portions of coal by a foul-air drift?—I never knew nature for to make any coal without backs or clearages.

2931. Are you not aware, that where there is no known disruption of the stratification for a very considerable extent, that still any portion of that coal immersed in water may be seen visibly to give out carburetted hydrogen gas?—Yes; I am aware there were five ships blown up on the Tyne and Wear, after being brought from collieries in which there was no fire, which were only covered by the tarpaulin. The names are mentioned in the local records.

2932. Is not that a proof that the whole of the foul air cannot be cut off by any gas drift?—I cannot speak to that. In every colliery I have ever been in or seen, and I have been in many collieries in Staffordshire, that I did not ventilate, that other people ventilated on my principle; my principle is driving a board along the fault.

fault. I think that the Legislature might say, you may go to a fault, and that although this may be in A., B. or C.'s property, still you shall have the liberty of going to that fault, making compensation to the party, and cutting a drift along that fault, be that property whose it may. The further that that is off the better, because the gas, whatever force I may use, admitting that I go down this morning, when the air balances 31 inches of mercury; in an hour after it falls to 28 inches on the diluting system; the gas then rushes into the works among the men, and explosion is a consequence. In mines, if I can force it into this drift at all, it can never go back, because gas is lighter than air by double; not only so, but it will rarefy this gas course; by which I conceive that the parishes could look after the gas course, and old pauper colliers could go down and look whether this gas course was in action, or whether the gas was increasing, which could be done by a small balloon being put into the place, that would tell whether the gas was increasing or the air. Then by driving a drift along, let me be shown any colliery in England, and I can prove the matter in a week; the first blower cut in, a week will prove the matter. If I drive along here to the first blower, and I carry it for a mile distance, and then I can stop that blower, and bring it in here into the gas course, I prove the fact. Then is it not natural for the gas to rather flow up than downwards into itself, than into cold air?

2933. But you are supposing all the way through your evidence that the gas is only perceptible at certain interstices?—Yes; if coal is at all porous.

2934. It is quite clear from the evidence laid before the Committee, that it may be found in the most minute vescicles in the coal, as a composition?—Yes; it mixes in the cutters. These I call the cutters; these I call the backs. The gas is made through every particle and every opening; but if coal were as solid as an anvil there could be no gas come out of that. If coal were a perfect solid the collier could not get it down the colliery. Although he is ordered to hole in only 30 inches, he will hole in 34 or 36 inches, till he gets to the back or breaks down his work; he is sure of meeting that from 30 to 36 inches.

2935. Do not you know, on account of there being no such backs, that gunpowder is resorted to to detach the mass?—But suppose there is gunpowder; I resort to gunpowder to take down the coal, although there are backs.

2936. In many collieries there is no sufficient perceptible cracks or fissures in the direction in which the coal is necessarily wrought?—I never knew a coal field without backs. I never had one under my inspection; nor do I think there can be.

2937. What admixture of atmospheric air do you apprehend to be necessary to reduce carburetted hydrogen below the explosive point?—Fourteen to one will barely do; but I always recommend 20 at least. Calculating upon the blowers that come in unawares, if in the diluting system, which I would not practise on any account.

2938. Now have you ever tried any experiment with the lamps?—I did.

2939. What is your view with regard to the safety lamp?—I was asked by Mr. Allen of this town, my opinion of the safety lamp, and a lamp was put into my hand in 1817, by Mr. Cooper, to try its effects. I exploded the lamp by simply putting a saucer on the top, and by putting the current down in that way, (*describing it,*) I exploded the lamp. I then wrote a note to Newman-street, to the person who made Sir Humphrey Davy's lamp, and told him if he could make me one as good as that I would call for it as soon as it was done; that I was going to explode it. He did so. I went to the gas works in Peter-street; I exploded it there; and I was then challenged in the matter, and in the Society of Arts' rooms, before a large committee in that house. I exploded it with throwing coal dust at it; with changing the current of air, and taking and putting it there; or taking it to the door, and shutting it, I will explode it by that; I will explode it by my coat, or I will explode it by my hat. Anything that would produce a current. It is a very extraordinary fact that this never appeared in the Transactions of that Society.

2940. But are you not aware that Sir Humphrey Davy gave positive directions to all those who were likely to avail themselves of this invention, never to allow the lamp, on any consideration whatever, to be exposed to a sudden current?—I never heard that. I heard Sir Humphrey Davy on the thing, and I never heard him say that. I wish he had published that, it would have saved many.

Mercurii, 8° *die Julii*, 1835.

JOSEPH PEASE, ESQUIRE, IN THE CHAIR.

Mr. *George Stephenson*, called in; and further Examined.

Mr. *G. Stephenson.*

2941. THE Committee understands that it is your wish to elucidate some portion of your evidence, by one or two further remarks. Will you have the goodness to make those remarks?—Having understood that evidence has been given here that Sir Humphrey Davy's lamp will explode the external atmosphere when it comes in contact with a sharp current of air, I think I can show the Committee how such a current may daily take place in the working of the coal. The custom of getting the coal in the north, is by boards of five or six yards wide; the coal is undermined first, about three feet in; it is then cut up at the two sides, (if it is brought down by gunpowder it is only cut up on one side, but if it is brought down by wedging, it is, generally speaking, cut up on both sides.) Now, the lamp is placed in as convenient a situation as the miner can contrive, that it may give him all the light possible; it is generally hung upon a prop, set up for the purpose. The coal being undermined and brought down by wedges, if there were any inflammable gas in that part of the mine, it would be close to the face of the coal. The coal frequently comes down very suddenly, so that the men must run back to keep out of its way; sometimes they are not quick enough, that it comes upon them and kills them; but they run out of the way as fast as they can, not stopping to take hold of the lamp, which is left hanging. When the coal comes down there is an immense gush of wind, immediately arising from the falling of the coal driving the hydrogen gas on the face of the coal, that was before hanging out of the way of the lamp, immediately against it, with a current which is, I imagine, sufficient to drive the flame through the gauze, and fire the external atmosphere. Of course, if the mine is an inflammable state, which it can be shown that it frequently is, an explosion must take place, and perhaps of a very considerable portion of the mine.

2942. Have you ever known of an incident that would justify such a supposition?—I have. I have been frequently in a board myself with a candle, when there was not fire-damp, and my candle has been blown out as described, by the falling of the coal.

2943. But you never heard of the gas exploding, either in a section of the mine or in a board-way, under those circumstances?—I have not myself. I imagine that some of the accidents that have happened, of which no one has been left to give account, may very likely have happened in the way I have described.

2944. The work generally closes by the middle of the day, does it not?—Not always. Some places are kept constantly going, night and day, notwithstanding the pit only works in the daytime.

2945. Are you acquainted with an instrument called an anemometer?—I do not know it by that name; to what purpose it is to be applied?

2946. It is for measuring the velocity and the strength of the currents of air?—No, I have not seen it.

2947. Then you are not able to state whether it is an instrument that may be relied upon?—No, I am not.

2948. Then you fully admit that the lamp may be exploded by the increased current of air, do you not?—I do.

2949. What is your opinion of the relative value of a furnace placed above the mine at bank, and one placed under ground at a suitable distance from the

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the bottom of the up-cast shaft?—The furnace being placed at the bottom of the shaft must be considerably better, on account of the difference of the depth. If a chimney were to be built at the top of the pit, as high as the one which the furnace at the bottom may have, then the chimney at the top would be as good, and perhaps better, but such a case cannot be expected to exist. The goodness of the ventilation depends on the length of the shaft; for it is a chimney in itself. Each particle of heated air becomes considerably expanded, and may be likened to a small balloon, which of course rises up to the surface with as great velocity as the heavy air presses round from the down-cast shaft, to fill up the temporary vacuum which is thereby formed. The longer the chimney, the greater velocity do these particles acquire. That is my reason for having the furnace at the bottom of the shaft.

2950. Then the placing of the furnace at bank, over the up-cast shaft, with a chimney of moderate height, can only be recommended in cases where that is found to afford sufficient ventilation; the mine below being very foul?—I think such a furnace might be useful in many cases; that is to say, that the combustion might be kept up by atmospheric air; and the current from the up-cast shaft, which may be supposed to be in an inflammable state, might then pass into the chimney above the fire, so as to be carried off by the assistance of the furnace, without ever coming into contact with the fire.

2951. Then you lay it down as a principle, that the chimney must have specific relation to the size of the shaft, to be equally efficient?—It must.

2952. The size and depth of the shaft?—Certainly.

2953. Have you anything further to say?—No, I have nothing further.

Mr. *John Buddle*, called in; and further Examined.

Mr. *John Buddle.*

2954. YOU were requested to compare the printed statement from Mr. Sykes' local records, and to ascertain how far, according to your knowledge, the same was correct; have you done so?—Yes, I have done so, and I find some omissions. I have completed a list myself, which I should beg to be permitted to make a fair copy of, to present to the Committee; and in the meantime I will place that in your hands [*handing in a List.*] I have designated those in which I have been personally concerned by asterisks (*); and those in which I have only been called upon in consultation, but not immediately concerned in, are marked with a dagger (†).

2955. I observe with reference to the accident, June 30, 1817, at Row Pit Harraton, you notice that that mine was exploded by the obstinacy of a young man, a workman, whose candle was twice put out after his refusal to use the lamp, but that persisting in it the third time, he was instrumental in destroying 38 of his fellow labourers?—He was. There was a very decent man, his comrade, working in the same place with him; the overman went in with them in the morning and showed them the danger; for although there was no gas in the place they were working in, at about 12 yards from them, in what we call the *return* from the place, which is the way the current of air was going, he actually took them in and showed them that it was explosive. He cautioned them by no means to expose a naked light, inasmuch as they were subject to the operation of what we call backing of the foulness, against the current of air upon their lights. He gave them this caution and went about his business. When this headstrong fellow told his comrade that he could not see with that thing, meaning the Davy, and would insist on screwing off the gauze cylinder and taking his candle, the other remonstrated with him; told him he was aware of the danger, and he really durst not stop if he persisted in unscrewing the Davy; however, after what I have stated, after two or three attempts at the lamp, he obstinately took off the top of it. I am not quite certain whether he lighted a candle, but he worked with a naked light. The other man was so sensible of the danger that he immediately went away, and in going out-bye he saw the overman and requested him to go immediately in to Moody, as he was quite sure he would do a mischief. He then came to the surface; he then rode, as we call it; he came up the pit, and in a very few minutes the explosion happened. I happened to be in a situation where I saw this explosion; it was rather an eruption than an explosion. It was a most curious phenomenon; it

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continued for above five minutes to vomit out a column of black smoke, which ascended an immense height into the air, like a waterspout. It was a very fine day, there was only a gentle breeze of wind from the west, and I saw it feeding till the mass of black smoke and coal-dust formed an immense cloud immediately over the pit, with a narrow stalk to it, the diameter of the shaft. A kind of explosion took place at length, which cut off the stalk from the top of the pit, and then this immense cloud was carried away by the gentle breeze, and deposited its contents over the country for perhaps two or three miles. I made the best of my way to the pit, and when I arrived there everything was blown away from its mouth; the metal pulleys that the ropes go over were carried to a distance, the shaft framing was totally blown away, the ropes were blown out, and there were two mangled carcasses lying within a little distance of the mouth of the shaft. There was a body cut in two, the trunk and arms without the head were lying in one place, and the legs and thighs lying at four or five yards from it. At about 12 yards from the pit there was a body lying without a head.

2956. What was the depth of the shaft?—Eighty fathoms.

2957. How far do you conceive those workmen were from the bottom of the shaft at the time the explosion took place?—We ascertained that accurately afterwards, for one of them was the body of a boy whose father was the onsetter at the bottom of the pit: and it shows how a little shelter in some cases on those occasions will protect a man. The onsetter always has a little recess in which he keeps what we call the chalking board, on which he chalks down the quantity of work done by each collier; and this little boy (it was his first day of being at work) was at a door very near the shaft, and he frequently came to his father in the course of the day; he had just come to him; at the instant the explosion happened the man held the boy's hand with one of his, while with the other he was chalking on his board, his body being within the recess niche in the coal: the boy was carried up the pit in the way I have described, and the man was not the least injured. The other man, whose name was Allen, I believe, was standing at the bottom of the pit, leaning with his elbows on a corf, talking to the onsetter; he disappeared in an instant, and was blown out at the top of the pit. It was clear from the appearance after we got down the pit to seek for the bodies, that the fire had taken place where Moody was working, as the very first stroke of the fire had been there, for his body was almost burnt to a cinder, and the poor unfortunate overman was found within about 40 yards of him; he had never reached him.

2958. Are there any other of the accidents in the list which you have produced, to which you are inclined to call the attention of the Committee, as connected with their immediate causes?—I do not know, they are so very numerous.

2959. Are you acquainted with an instrument called an anemometer?—I have seen several of various kinds, but none of them satisfactory. I have a very simple practical mode of coming at the same result, which is quite sufficient for my purpose.

2960. Will you state what practical method there is, sufficiently familiar to a common workman (an overman), by which he can ascertain, in the absence of the viewer, that the current of air which is intended to be kept up is in active coursing?—Yes: I generally select a particularly clear passage, which almost every mine affords, in some part or other, in the principal air-course; I take its dimensions, as, for example, six feet square, or any given dimensions, it is of no great importance what the area is, and I place a mark to commence at. I just take the ordinary pit-candle, the standard pit-candle, which in our country are 45 to the lb.; there are all sizes of candles, as 30 or 40 to the lb., but the standard pit-candles are 45 to the lb. I make a mark, and take one of these candles; the current will sensibly bias the flame of that candle, and act so forcibly upon it in a small air-course as in a little time to eat out the flame: that is one gauge. We do not consider an air-course sufficiently powerful unless, in a given dimension which has been fixed upon, the current, holding the candle quite still in this manner, will in the course of a minute, less or more, what we call "eat it out," that is, destroy the flame. Well, I just take this candle, and I go a little back from the mark, and stand in this manner and try it a few times till I ascertain the velocity of the current; I then just walk

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on with the same velocity as the air, consequently the flame burns perpendicular. I generally take 20 yards as a fair distance for ascertaining the velocity of the current; from practice I can do it very correctly; I generally take the average of three trials, and I can do it with very great correctness in that way. I then set up a mark at the end of the 20 yards' stage, which forms the standard air-gauge. The inquiry of the overman is, "how is your air going this morning?" well, 50 seconds, 60 seconds, 75 seconds, &c. Then of course all is not right if there is any slackening in the standard speed of the current, which a reference to the gauge shows at all times. If they find the current languid they know that there is something amiss, that something has happened, and an inquiry is immediately made and the cause ascertained. That is the mode which I have always pursued; it is a very simple practical method.

2961. Now, calculating upon the number of feet per minute, how many feet per minute would produce that "eating out" of the candle which you have instanced?—It depends altogether on the area of the place; the same quantity of air moving in an area of 50 feet might not put out the candle, while the same volume moving in an area of 30 feet would.

2962. Well then, take any given space?—I take a given space.

2963. Will you assume some space?—I will assume 30 feet; at a speed of four feet per second, that would very soon eat out a standard pit-candle.

2964. Now, supposing no obstruction which was apparent had taken place in the air-coursing, and you found that the velocity was not equal to your wishes, what means would you resort to, to increase that air-coursing?—We immediately know in such a case that it arises from the neglect of the furnace, and that the remedy is, more fire to be applied. We can tell when the furnaces are what is called damped; it is frequently necessary to smother them up with small coals when the shafts have to be repaired above, otherwise the sinkers or shaft-men going in for repairs could not bear it; but in those cases when our returns are heavy, we always have a waste-man or two below to watch the candle, to see that the return current does not get inflammable. If it begins to get heavy he immediately gives notice, and the cradle is taken out, that is, the circular scaffold on which the shaft-men work is drawn out, and the furnace is pushed away as hard as possible until the return current becomes clean again, or at least until it is improved: we call it "cleaned," which perhaps is the best expression.

2965. Then any neglect in the precaution you have mentioned would immediately endanger the lives of the men in that mine?—Of course, if permitted to go on; but in all such cases we keep waste-men watching the return, they continually watch the candle every two or three minutes; they judge of the state of the air from the appearance of the apex of the flame, it becomes elongated; they screen it by putting their hand before it; and according to the size and colour of the apex of the flame, (for both are to be taken into consideration), they judge of the degree of inflammability.

2966. You have stated that there has become much less difficulty in ascertaining the admixture of foul air since the introduction of the lamp?—I mean that to apply generally; I mean to say I am out of practice myself; I do not pretend to be so good a judge of the candle as I was before we got the Davys, when I had daily practice, but I also feel if the Davy were taken from us I should soon acquire my wonted dexterity in the judgment of the candle. We have not occasion to resort so much to the show of the candle as we had before the invention of the Davy; and I should, therefore, rather take the opinion of our overmen and waste-men, at this moment, who are in the full practice of the candle, than I would take my own in very critical cases.

2967. Have you ever tried the plan of two separate air-courses travelling in the same direction, at different intersections of the mine?—With communication, or without communication?

2968. Without communication?—Yes, and we frequently have them running in parallel directions with separations, one current going up one passage and another going up another.

2969. Is not that a valuable precaution, lest anything should happen in one of those courses?—Of course; that is according to the system which has

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been practised for many years, more than 20 years. That is what I call the double air-course, mentioned in another part of my evidence.

2970. But it gives you the opportunity of shortening the air-courses and ensuring the ventilation over the others?—It does very much; it gives us shorter runs, long runs being no object to us, since we did not bring the foul returns upon our furnaces. But I wish it to be understood that when we had only one furnace under Spedding's system, when we had only one furnace to bring our foul returns upon, we gave the air all the length of run we could, in order to have it mixed as much as possible, with a view to reduce it below the firing point.

2971. It diminishes the strength of the current in each, does it not?—Do you mean the divided air-coursing?

2972. Yes?—No, very little. I think that the velocity is increased in the main trunk, so as to supply the branches. I cannot say I have perceived an injurious diminution of air in the splitting of it, provided there is room enough afterwards from the outlet passages.

2973. Now, have you any idea what number of cubic feet of atmospheric air passed through Wallsend colliery in the course of a minute, prior to the accident?—Yes; I have not the least doubt but that there were 5,000. There were in fact three down-cast pits, and I should put them, on a very moderate computation, at from 1,500 to 1,800 or 2,000 cubic feet a minute each. I am speaking within bounds; I am quite sure I am within bounds when I say that the whole quantity was 5,000 cubic feet a minute.

2974. I believe you have the charge of Lord Londonderry's colliery at Pensher, near Houghton-le-Spring?—I have.

2975. You are aware that one of your overmen, Mr. Elliott, has been examined before this Committee?—I suppose he has, but I know nothing of his examination; I have not seen it, nor him since.

2976. I think he stated that in that mine you were working the Hutton seam and the Maudlin seam?—Not at present; the Tinquarter seam is now working.

2977. Had been?—Yes; they have been all worked.

2978. And he stated, I think, that the rate of the air in the D pit was 12 feet 6 per second?—Yes, perhaps it might; I have not measured it myself.

2979. That the area was 40 feet, and that he estimated the quantity of cubic feet per minute at 30,240 feet?—Well, that is a matter of figures; I believe it may be right; it is merely the area to be multiplied by the velocity.

2980. He stated that in the same pit the total of the three divisions in the Hutton seam, in which he named there were five divisions, that those divisions uniting 250 yards north-west of the shaft, and passing over a steam-engine furnace into an up-cast shaft, the rate was 75 feet, the area 42 feet, and the quantity in cubic feet per minute 18,900; the calculation was 49,100 cubic feet, which ascended a pit six feet and a half diameter, at the rate of 24 feet and a decimal of five per second?—He must have tried it, I never did; but in that particular mine we sunk an air-shaft on purpose, a separate pit. There are three pits sunk close together; there was no difficulty in the sinking; no quicksand, no feeder of water; there were two coal pits, and we sunk an additional one for the sake of ventilation, merely as a furnace pit.

2981. He says the pit is ventilated with two down-casts, or rather there are three down-casts to two up-casts?—There is another pit leads to it; there are three down-casts.

2982. Now there is no difficulty in working that colliery, is there?—Not by common attention; but whenever the pillars are worked an unventilated part is formed, and the same difficulty arises that is to be encountered in all those collieries where pillar-working is carried on. It does not signify what force of ventilation you have, if it cannot be applied to dislodge the gas; and so long as the current of air can only be applied merely to the skirts or margin of the goafs, to carry off the feeders of gas exuding from them, by the gas drifts through the dumb furnaces, no improvement whatever is effected: unless therefore, some mode can be devised of completely expelling the gas from those lodgments, nothing can be done for us that has not already been done. All the schemes which have been devised for removing or drawing off the gas by pipes, or anything of that kind, really amount to nothing; for until some effectual plan can be devised for dislodging and expelling the gas entirely and effectually

effectually from those lodgments occasioned by working the pillars, the chief cause of all our accidents will I fear remain unabated.

2983. Do you think that the shafts at Pensher emitted, as the witness Mr. Elliott states the east shaft did, 51,900 cubic feet of air per minute?—I never have measured what they emitted; I am always satisfied to measure what is going below, and I do not, for my own part, exactly know how the quantity emitted can be measured, I have found it rather a difficult matter to ascertain the exact velocity of an ascending current of air; because it is clear that you must have some body of nearly about the same specific gravity of the air, to rise with the ascending current; if it is at all heavier it will not give the true velocity. I have tried various things: I have tried down, the finest down; but the best thing that I have tried is tobacco-smoke. I think that ascends nearly as quick as anything that I have tried. Soap-bubbles are very good, but then they are so subject to be dashed and broken against the sides.

2984. Now, do you think it is possible to let in a portion of the mine in the Bensham seam, and leave air-courses so as to intersect the goaf?—I think not. I cannot see how it is possible to be done; that is, to work away the coal, and leave air-courses at the same time.

2985. Do you mean on the score of impracticability, or the impossibility of working a mine to advantage on any such principle?—On the score of impracticability. I do not know how the goaf is to be got through with air drifts.

2986. Of course the question must allude to the propriety or the possibility of leaving bearers sufficient to protect those air-courses adjoining to the goaf?—Yes; that is, if the air-course is merely to sweep the gas away as it exudes from the goaf, sufficient pillars must evidently be left to form a pipe for that purpose; but there is no means of getting through a goaf, excepting those which I mentioned in that letter of mine to Sir Ralph Milbank, by a centre passage for the current of fresh air to be taken in, and two flank passages, one on each side, to carry off the adulterated current; but the difficulty of this operation is that you cannot use gunpowder. It is possible to penetrate a goaf in that manner, but the expense would be enormous, because you cannot use gunpowder to blast the blocks of stone which lie in the way. The expense would be almost intolerable. But if even that were done it would only be like boring a hole through the middle of a cask, as the ventilation could not distribute itself further than merely between those draughts; it would just make an air-pipe that might travel through the goaf, but still on the two sides it would remain quite full. It would therefore at last come simply and precisely to the same position as we stand in at present. We should have one fresh-air current, and a foul-air current on each side of it, still leaving us as at present with an immense collection of gas on each side of us.

2987. Have you ever had the opportunity of considering a proposition for supplying the workmen, in case of choke or after-damp, with a vessel of compressed oxygen or atmospheric air?—I have heard of such a scheme.

2988. Have you ever thought on the subject?—I have.

2989. Do not you think that a supply of 20 or 30 minutes' respirable gas would save the life of a man frequently so situated?—I think it would; but for my part I cannot conceive how it is to be applied.

2990. You would think, if any scientific man could suggest a portable magazine of that kind, which might be at hand or within reach in the course of a few minutes prior to suffocation intervening, it would be a valuable measure?—But that would be pure oxygen, I presume, in some vessel. What might be the effect on the lungs of breathing only pure oxygen, I do not know.

2991. You are aware a mixture might take place previously to its being inhaled?—I conceive there would be no mode of inhaling it but through a pipe. I have known such a scheme suggested; but we are to presume that the poor collier is perhaps reduced to a state of insensibility at the moment, by the effects of the explosion.

2992. But you cannot conceive that in all cases?—Not in all cases, but I am afraid too generally it would. If he were provided with an apparatus of this sort, it might give him a chance, but I very much doubt the practicability of his applying it with advantage.

2993. In many of the cases which you have instanced at Wallsend, the inference is very strong that the parties continued to exist for a considerable time after they were aware of some accident having occurred?—Yes; and they

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they travelled a distance of, I should say, about 500 yards before they were suffocated.

2994. Have you seen a proposed improvement of the lamp, lately suggested by a gentleman or a tradesman in Newcastle, of the name of Ayres?—No.

2995. Is there anything that you wish to remark, after having read the evidence with which you favoured the Committee on former sittings?—I do not think there is. There are innumerable things in practice, which in fact if I were to go into fully, would amount to an absolute essay on coal mining: as for instance, we always have a succedaneum in the case of the return current to the furnaces becoming too heavy. If by possibility our fresh-air current (the clean return, as we call it) should get foul, and it became necessary to extinguish the furnace, there is nothing to do but to throw open the nearest main doors to the furnace, and give it the full current of fresh air. By this means the whole circulating current is suspended, and the furnace is only fed with the current of fresh air until it can be extinguished; and as soon as that is done, the doors are put to again, and the foul current is discharged with safety through the cold furnace. We frequently had occasion to resort to this expedient under Spedding's system, when we had no separate return for the foul air. I will give one instance of the practical effect of this plan. One of the returns at Jarrow colliery fired at the furnace, but an explosion was prevented by the great presence of mind and dexterity of this young man, Alexander Hall, by what I call real good pitmanship. I just name this instance to show what a man can do who has a thorough knowledge and understanding of his profession, and who has also the presence of mind and pluck to carry a decisive measure into operation. The pit was not at work, but there were a number of people down about various jobs; waste-men and other people. They were not in the heavy return, but they felt an extraordinary sensation in the air, which drew their immediate attention; the furnace-men came running out, and informed them that the West Pit furnace had fired; the expression is, "she has fired at the West Pit furnace," meaning that the current of air had exploded at the furnace. But it is frequently the case under such circumstances, that before the explosion takes place, there is a kind of libration in the ignited current, the flame not extending very far back from the furnace; it goes backwards and forwards a few times before the explosion takes place. This was the case at Jarrow, when Alexander Hall, the under-viewer, (many of the men went in-by, and sat down out of the way quietly to await their fate,) with the utmost presence of mind and dexterity, ran and at once threw open the main droves in the rear of the burning current, by which the whole body of the fresh air was thrown in behind the fire, and instantly cut it off from the explosive current; that is to say, this rush of fresh air cut the gas off from the flame, and carried it up the shaft without an explosion.

2996. How many lives did that save?—I really do not know; perhaps there might be 20 or 30 people down at the time; but in an instant all was quiet, the flash was carried off; no explosion took place, and all was right again. I gave the young man the greatest possible credit for his judgment, decision and dexterity; it was almost one of the cleverest things of the kind I ever knew done.

2997. Are you aware of any recent accidents since you left the north, in the mines of your district?—Not by fire, I have not heard of any; but I have had a letter this morning informing me that six men have been killed by the breaking of a rope at Burdon mine colliery.

2998. Any other?—And one or two killed by stone in Killingworth, and another (the seal was broke at the place,) but I think it says found dead.

2999. Do accidents frequently happen from the breaking of ropes?—Very seldom indeed; I have not known, I think, in the whole course of my life, above a dozen, or a score perhaps.

3000. You cannot of course, from any information you have received, state whether the workmen were coming up alone, or with coals?—No; it seems rather extraordinary that six should be killed; I think they must have been at work in the shaft, or that three have fallen upon three. I have heard of seven people being killed in this manner; I have sometimes known men killed by falling upon each other. The men frequently ride against each other; it is possible that three going down, may have fallen against three coming up.

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3001. Is it not the duty of the bankmen to prevent men descending after they have received a signal to draw men?—No, not unless by special order.

3002. Do not you think such special order absolutely necessary?—The men are at liberty to ride whenever they please; the only caution is that they shall not carry anything. I have known men killed by others carrying tools; I have known men killed by the drill falling out of another's hand, and by the hammer falling out of another's hand; but our orders are that they shall not ride carrying anything, even bottles they are not allowed to carry.

3003. Nor their lamps?—Nor their lamps, unless in their pockets very carefully. They only carry the gauze, the upper part; they do not carry the bottom.

[*The Witness delivered in the following List of Accidents, &c., and the same was read.*]

EXPLOSIONS, INUNDATIONS, &c., which have taken place in the Coal Mines of *Northumberland* and *Durham.*

[Extracted from Mr. Sykes' Local Records of the Counties of Durham and Northumberland. —Corrected by J. Buddle, Esq.]

Time when.	COLLIERIES.	CAUSES.	Lives Lost.	—
1658, May -	Gallow Flatt -	inundated -	number unknown	(*a*)
About 1710-	Bensham - -	exploded -	70 to 80	(*b*)
1743, Jan. 18	North Biddick -	- ditto -	17	
1756, Aug. 11	Chaytor's Haugh	- ditto -	4	
1757, June 10	Ravensworth -	- ditto -	16	
1760, June 15	Long Benton - - - - - - -	- ditto -	1	
1761, Dec. 1	Hartley - - - - - - - -	- ditto -	5	
1765, Apr. 2	Walker - - - - - - - -	- ditto -	8	
1766, Mar. 18	Ditto - - - - - - - -	- ditto -	10	
— Apr. 16	South Biddick - - - - - -	- ditto -	27	
— Aug. 22	Lambton - - - - - - -	- ditto -	6	
1767, Mar. 27	Fatfield - - - - - - -	- ditto -	39	
1768, Dec. 21	South Biddick - - - - - -	- ditto -	–	
1773, Dec. 6	North Biddick - - - - - -	- ditto -	19	
1776, Oct.	East Rainton (Sykes p.) - - -	- ditto -	2	
1778, Dec. 8	Chaytor's Haugh - } Missed in Sykes	- ditto -	23	
1780, Aug. 21	Birtley North Side - }	- ditto -	3	
1782, May 17	Fauld Pit, Gateshead - - - -	- ditto -	4	
— Oct. 11	Wallsend - - - - - - -	- ditto -	1	(*c*)
1784, Nov. 6	Ditto - - - - - - - -	- ditto -	3	(*d*)
— Dec. 12	Ditto - - - - - - - -	- ditto -	2	(*d*)
1785, June 9	Ditto - - - - - - - -	- ditto -	1	(*e*)
— Dec. 4	Ditto - - - - - - - -	- ditto -	2	
1786, Apr. 9	Ditto - - - - - - - -	- ditto -	6	
1790, Oct. 4	Ditto - - - - - - - -	- ditto -	7	
1793, — 27	Sheriff Hill Hope Pit - - - -	- ditto -	14	
1794, June 9	Picktree, near Chester-le-street - -	- ditto -	30	
Between 1783 and 1794.	Washington - - - - - - - -	- ditto -	2 overmen	
	- Ditto - - - - - - -	- ditto -	1 overman 1 viewer.	
	Lambton A. Pit, Burnman - - -	- ditto -	1	
	Ditto B. Pit - - - - - -	- ditto -	several.	
	Ditto Lady Ann Pit - - - -	- ditto -	2	
1794, June 11	Harraton - - - - - - -	- ditto -	28	
— Nov.	Globe Pit, Ox Close - - - -	- ditto -	2	
1795, Apr. 24	Benwell - - - - - - -	* ditto -	11	
1796, Feb. 12	New Washington - - - - -	* ditto -	7	
— Apr.	- Ditto - - - - - - -	* ditto -	2	
— Sept. 8	Slaty Ford - - - - - - -	inundated -	6	

(*continued*)

(*a*) Drowned by breaking in of water from an old waste.

(*b*) This was the first attempt made to work the low main seam in the neighbourhood of Newcastle.

(*c*) The coal set on fire, and the colliery drowned up to extinguish it.

(*d*) Supposed to have taken place at the spark of the steel mill.

(*e*) This was the first explosion which was distinctly known to have taken place at the steel mill.

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Time when.	COLLIERIES.	CAUSES.	Lives Lost.	—
1798, Feb. 27	Washington	* exploded	7	
— May 22	Ox Close Globe Pit	- ditto	4	
1799, Oct. 11	Lumley	- ditto	39	
— Aug. 13	Newbottle	- ditto	1	
	Ox Close A. Pit	- ditto	1	
1803, Sept. 3	Wallsend	* ditto	13	
	Morton Pit, Lambton	† ditto	2	
1805, Oct. 21	Hebburn	* ditto	35	
— April	Ox Close A. Pit	- ditto	2	
— Nov. 29	Ox Close	- ditto	38	
1806, Mar. 28	Killingworth	† ditto	10	
1808, Nov. 29	Harraton	* ditto	4	
— Nov. 30	Footfield Hall Pit	- ditto	3	
— Aug. 31	Shiney Row New Pit	- ditto	2	
— Nov. 30	Footfield Hall Pit	- ditto	3	
1809, Sept. 14	Killingworth	- ditto	12	
1812, May 25	Felling	† ditto	92	
— Oct. 10	Herrington Mill Pit, Pensher	* ditto	24	
1813, July 17	Collingwood Main	- ditto	8	
— Sept. 8	Hall Pit, Fatfield	† ditto	32	
— Dec. 24	Felling	† ditto	22	
1814, Apr. 5	Howden Pit, Percy Main	* ditto	4	
— Aug. 12	Hebburn	* ditto	11	
— Sept. 9	Leafield	- ditto	4	
1815, May 3	Heaton Main	* inundated	75	
— June 2	Success Pit, Newbottle	exploded	57	
— June 27	Sheriff Hill	* ditto	11	
— July 31	Newbottle	Bursting of a boiler of high pressure locomotive engine	18	
— Dec. 11	Sheriff Hill	* fire	5	
— Dec. 18	Townley (missed in Sykes)	exploded	1	
1817, June 30	Row Pit, Harraton	* ditto	38	(*f*)
— July 2	Nova Scotia, Harraton	after-damp	8	(*g*)
— July 21	Sheriff Hill, (omitted in Sykes)	* exploded	1	
— Sept. 25	Jarrow	* ditto	6	
— Nov. 3	Austin	- ditto	1	
— Dec. 18	Plain Pit, Rainton	- ditto	27	
1818, Aug. 5	Wallsend, Davy Lamp	* ditto	4	
1819, July 19	Sheriff Hill	* ditto	35	
— Oct. 9	George Pit, Lumley	- ditto	13	
1820, Apr. 28	Jarrow	* ditto	2	
— Oct. 1	Backworth, (not in Sykes)	* after-damp	1	
1821, July 9	North Pit, Rainton	* exploded	1	
— July 9	Cox Lodge	- ditto	1	
— Oct. 19	Nesham's, Newbottle	- ditto	6	
— Oct. 23	Wallsend, Russell	* ditto	52	
	Felling	- ditto	6	
1823, Feb. 21	Ouston	- ditto	4	
— June 19	Walker	Falling in of earth	6	
— Nov. 3	Plain Pit, Rainton	* exploded	59	
1824, Oct. 25	George Pit, Lumley	- ditto	14	
— Nov. 19	Dolley Pit, Newbottle	- ditto	11	
1825, July 3	Jadeth Pit, Fatfield	- ditto	11	
— Oct. 5	Hebburn	* ditto	4	
1826, Jan. 17	Jarrowe's	* ditto	34	
— May 30	Townley	* ditto	38	
— Sept. 5	Heworth	- ditto	5	
— Oct. 27	Benwall	* ditto	2	
1827, July 20	Charles Pit, Lumley	- ditto	1	

(*f*) Occasioned entirely by the perverse obstinacy of a young man named John Moody, one of the hewers, who, in defiance of the orders of the overman, refused to use Sir H. Davy's lamp, and lighted a candle, which was twice put out by the workmen whom he was to relieve; but he re-lighted it by unscrewing the lamp, and thus sacrificed his own life and the lives of his companions.

(*g*) Were killed by the choke-damp, which had entered the workings, supposed from the Row-pit, subsequent to the explosion.

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Time when.	COLLIERIES.	CAUSES.	Lives Lost.	—
1827, Sept. 5	Fawdon - - - - - -	exploded -	2	
1828, May 15	Jarrow - - - - - - -	* ditto -	8	
— Sept. 1	New Pit, Houghton-le-Spring - - -	- ditto -	7	
— Nov. 20	Pit Washington - - - - -	* ditto -	14	
— Dec. 1	Townley - - - - - -	inundated -	1	
1829, May 13	Killingworth, Westmoor - - -	exploded -	1	
— June 26	Dorothea Pit, Newbottle - - -	- ditto -	1	
— Dec. 3	Willington - - - - - -	- ditto -	4	
1830, Aug. 3	Jarrow - - - - - - -	* ditto -	42	
— Nov. 27	Hebburn, (not in Sykes) - - -	suffocation -	2	
1831, July 9	King Pit, Wreckleton - - - -	exploded -	3	
— Sept. 20	Willington - - - - - -	* ditto -	7	
1832, Mar. 8	Beamish - - - - - -	inundated -	2	
— June 15	Newbottle - - - - - -	boiler exploded	12	
— Nov. 13	Heaton - - - - - - -	explosion -	1	
— Oct.	Wallsend - - - - - -	* ditto -	1	
1833, May 24	Great Lumley - - - - -	- ditto -	2	
— May 9	Springwell - - - - - -	† ditto -	47	
— Nov. 8	Blackfell - - - - - -	- ditto -	3	
— Nov. 22	Mawsby - - - - - -	- ditto -	6	
1834, Nov. 24	St. Lawrence - - - - - -	- ditto -	3	
1835, June 18	Wallsend - - - - - -	* ditto -	101	

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John Henry Vivian, Esq. (a Member of the Committee), stated as follows.

J. H. Vivian, Esq.

3004. WERE you acquainted with the late Sir Humphrey Davy?—Sir Humphrey Davy was a personal friend of mine.

3005. Had you ever an opportunity of seeing that lamented gentleman after his visit to the north of England?—I had.

3006. Did he state to you any opinion relative to the scientific or chemical means adopted for ventilating the mines of that district?—I perfectly recollect Sir Humphrey Davy telling me, on his return from the mines at Newcastle, that he considered the system of ventilation as perfect as it could be, that nothing more could be done in that respect.

3007. Then your opinion is, that in looking at the great dangers attending upon working those mines, all that was required at the hands of science was the means of producing sufficient light for the workmen without endangering explosion?—That was the object which Sir Humphrey Davy had in view in recommending the safety lamp.

3008. You are yourself interested to a great extent in mining operations, I believe?—In mining operations in Cornwall.

3009. In which you have no annoyance from the foul air found in the coal mines?—None whatever. They have no inflammable air in the mines of Cornwall.

Richard Smith, Esq., called in; and Examined.

R. Smith, Esq.

3010. WHERE do you reside?—At 29, Connaught-square, London.

3011. What is your profession?—A mining engineer.

3012. In what districts of this country have your professional services been chiefly exerted?—Chiefly in Staffordshire.

3013. Will you name any particular mines which have been under your personal inspection?—Tibbington Colliery, Tipton Moat Colliery, Deepfield Collieries, Walbrook Colliery, Parkfield Colliery, Parkfield New Colliery, and several others.

3014. Are any of these collieries of considerable depth?—Not more than about 150 yards. I am speaking now of the thick coal.

3015. You have in this field both the thick seams and the thinner seams?—Yes.

3016. Do you consider the thick seams, or the thinner beds of coal, more liable to annoyance from the effusion of carburetted hydrogen gas?—In some places the one and some the other, but more particularly the thick coal.

3017. Now, is it in the thick coal to an extent that interrupts your workmen?—I consider that they are not very much interrupted now, but they were formerly very much indeed: by gas, you mean hydrogen gas?—Yes.

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3018. Now, will you state to the Committee your former system of ventilation, and that you use at present, which you consider superior?—The former system of ventilation was carried on by driving small head-ways from the shaft into the sides of work alongside the main gateway, or way-gate; and it was the custom to force air into the side of work through the small headways, for the purpose of what was then called killing the gas, or what was more commonly known by the name of sulphur in those days.

3019. The word killing having merely an allusion to such oxygenation as would render it innocuous?—Yes. But as the coal in the higher seams of the thick bed were excavated, the gas lodged in the chambers thus formed, and the plan then in use had not the desired effect. The consequence was, that they resorted to the use of firing lines. The lower part of the chamber was cleared by means of forcing in air, so that a workman was able to take a candle, and upon the system of creeping below the inflammable gas, he could erect a long pole with a hole or pulley at the top of it, through which a copper line was threaded; and after fastening a lighted candle at one end, he would take the other to some place of security, and when there, would pull the line till the candle got up into the inflammable gas, when the whole would explode. By that means the work was freed for a time from gas, and the other workmen would descend the pit and go to work. That was the ancient method of clearing away the gas in the Staffordshire mines.

3020. That was used in the thick mines only?—Yes, in the thick mines only.

3021. What mode has been more recently adopted?—At the time that this was in practice, a person of the name of Ryan, who has been examined here, came into the neighbourhood, and he certainly threw some light on the principle of ventilation. He made use of some air-pipes, which he carried from the mouth of the small head up to the upper workings of the thick coal; and by converting the head into an up-cast, instead of a down-cast head, he by that means took out the inflammable gas that was hanging overhead, and thus drained the side of work completely. This led to the introduction of making top-heads generally. I believe some top-heads had been driven before that time; but instead of using them as drawing heads, they were used as driving heads, (if I am understood by the term.) They were used as down-cast heads, for the fresh air was thrown into the side of work to kill the gas, as it was termed, instead of drawing the gas out of it. By this means all top-heads in future were put into the up-cast shaft instead of the down-cast; and I believe ever since that time the system of ventilation has been found quite sufficient for the Staffordshire mines, where it has been carried on, and followed up carefully and properly.

3022. And that improvement arose out of the suggestion of Mr. Ryan?—I believe it did, as far as my experience goes it certainly did, and I always considered there was a great deal of merit due to Mr. Ryan for that suggestion; some people have contended he did not suggest it, but I have never been able myself to bring it home to any other person than to Mr. Ryan. I have considered him the inventor of a great number of schemes, some good, and others as they are; but, however, I give him the credit of that system.

3023. Has that plan been adopted in other mines besides Staffordshire?—I think it has been adopted throughout the whole of the thick mines in the Staffordshire coal field.

3024. Now, you have stated the ventilation now proposed is, in your opinion, quite adequate to the safety of the mines?—I think it is; and it can be easily explained by an old printed plan that I have in my hand, which has been in circulation for a number of years; I will hand it in, if you please.

[*The Witness handed in the same, and explained it to the Committee.*]

3025. Now, have you any other difficulty to contend with?—We have what is called the breeding fire.

3026. What do you mean by the term breeding fire?—I am now giving the local terms of the country, by which they will be better understood there, although perhaps not here. The breeding fire arises from the great quantity of small and refuse coal that is left behind in excavating a side of work: that may be called a side of work where the several pillars are that are shown on this plan. [*Pointing to another Plan, which the Witness also handed in and explained to the Committee.*] Those bearing the same numbers, are pillars in every separate

rate side of work, and we are limited to the number of pillars by the quantity of rubbish that arises in getting the coal, on account of the breeding fire. The breeding fire is from a great quantity of coal and rubbish; there are partings in the coal, bituminous schist, which is all left behind, and when it gets into the mine it begins to heat like a hot-bed, or like a new hay-rick, as it presses together till it fires by spontaneous combustion; we are obliged to shut up all the avenues leading to that side of work very closely indeed, in order to stove it out. That is the reason we cannot carry our sides of work to the same extent they do in other places.

3027. Which places you under the necessity of running your shafts throughout your field, at small intervals of space?—That is not altogether the reason we put our shafts so near together; one reason for doing that is on account of the thin mines, that we may get them the more easily. The expense of sinking shafts in Staffordshire is not so great as at Newcastle, (I never was there,) although when we meet with quicksands our expense is very considerable, but we never like to take our pits more than about 300 yards from each other. The plan I have produced shows a scale of nine pits, and each pit is supposed to get 15 or 16 acres of coal: the large shaded squares contain about four acres, and each square has five or six sides of work in it, which are divided from each other by the fluted ribs that are shown.

3028. Now, this spontaneous combustion has no effect in endangering the safety of the men?—No, it has not, except that they could not work, on account of the smoke which would arise from it. It would soon fill the pit full of smoke, and no person could exist.

3029. Is there always sufficient time for the workmen to retreat?—Always; it gives plenty of notice, sometimes several weeks' notice.

3030. It would endanger the mine, rather than the men?—Yes.

3031. By setting fire to it?—Yes; sometimes when a pit is nearly finished, it has been allowed to go on without stoving till it has fired; in that case the men are obliged to retreat and scaffold over the top of the pit, instead, as in other cases, what is more common, make dams in the ribs, and thus prevent the smoke from spreading through other parts of the pit. I have known breeding fire so difficult to extinguish as to be necessary to drown it with water. The mine engines are stopped, and water is turned into the pit from the surface, in times of flood, to extinguish the fire. But that was only in former times; mining is reduced to a better system, and such measures are seldom necessary now.

3032. It occurs by the decomposition of the minerals?—Yes; when the rock presses upon one of these particular heaps of refuse coal, by the falling of the roof, and a little water drops upon it to damp it, the steam first arises exactly like the steam of a hot-bed. It then becomes so heated as to fire of itself.

3033. But a very large accumulation of coal on the surface would fire, would it not?—I have known that to be the case with the small fine coal, but not if much mixed with the larger coal, which admits air more freely through it.

3034. Decomposition goes on more rapidly when water is admitted than in a dry season?—Yes, it does.

3035. Now, has no instance of explosion in any of the mines under your care ever come under your notice?—I have been fortunate enough never to lose any lives by explosion in the mines I have managed.

3036. How long have you been acquainted with mines?—From my youth upwards.

3037. Is it your opinion that no lives whatever can be lost by the explosion of gas in the mines under your care?—I do not think so, but I believe the system sufficient to prevent loss of life with proper care.

3038. Have any of your neighbours lost any?—Yes, they have.

3039. Will you state any mines in which such accidents have occurred?—Chiefly the Worcestershire side of Dudley.

3040. Are you intimately acquainted with that district?—Yes, I am.

3041. Have you descended the mines there?—I have.

3042. Have they the same seams as you have?—Nearly the same.

3043. Do they adopt the same system of ventilation?—The same system now, but not formerly.

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3044. Do you apprehend they have been entirely free from accidents since they have ventilated on the system you do?—No, I think not.

3045. How do you account for their having accidents when you have none?—I think it very frequently arises from inattention and obstinacy on the part of the men; they see no danger, and therefore they fear none in some instances. Sometimes the men have taken lights into places they ought not, and thereby injured themselves without injuring the other men. If the system of ventilation in the pit is properly pursued, I see little cause to be afraid of the loss of life by explosions there.

3046. Now, do you consider that in proportion to the extent of ground gone over, they have more gas to contend with than you have in Staffordshire?—It is all in the same field, only the one pit is in Worcestershire and the other in Staffordshire; but even in some parts of Staffordshire the gas is as prevailing as it is in the upper parts of Worcestershire.

3047. You are aware that some of these seams dip, and that the gas is found in greater quantities the further the coal lies from the surface?—Yes, I believe it to be generally the case.

3048. Is there any material difference in the depth of the shafts with you and the other districts you allude to?—Some are not so deep, and some are quite as deep, but there are very few deeper than 150 to 200 yards.

3049. You could not draw a comparison as to the difficulties?—Not from that cause.

3050. Could you from any other cause?—I think it much the same in all places, except that some mines are not so subject, and some not subject at all, to inflammable gas. But the principle which has been introduced has been found quite sufficient to ventilate any side of work that I have seen yet.

3051. Then the accidents that have occurred have been the result of wilful neglect or obstinacy, in your opinion?—When the word "wilful" is introduced it does not apply to my meaning; perhaps it is unintentional neglect.

3052. Carelessness?—I should say neglect and carelessness, unless it may have arisen from driving the bottom way-gate and the top air-head, before they are united or thirled; they are liable to little deposits of gas, and that might take place perhaps for want of the Davy-lamp being introduced. The men take the naked candle by accident or by thoughtlessness, and thus explosions occur, not enough to fill the pit, but quite sufficient to burn a man or to take away a man's life, or two in some instances; but that is a thing which seldom happens now.

3053. You are now including the Dudley districts in that observation?—Yes, I am, in the thick coal mines.

3054. How many men have been lost by any one explosion in any of the mines about Dudley, within your recollection?—I never recollect more than about eight or ten.

3055. Now, do you know any of the particulars attendant on any of those explosions in which those eight or ten men were lost?—To speak of my own knowledge I do not, because I never had anything to do with any mines where there was an explosion that took away the lives of men.

3056. Have you from authentic sources a description of the cause, or a notion of the cause of that accident?—The time I am speaking of was before the introduction of the Davy-lamp, and when the system of the firing line was used, but not since. I have not heard anything of that kind since; I have heard of two lives being lost or a solitary life, but very seldom.

3057 Then if you have no accidents from explosion, do you consider your workmen peculiarly liable to other contingencies affecting their health?—Very much so indeed, particularly in the thick coal, where they have to work up to such a height as 10 or 12 yards; they have not the opportunity of examining the roof to see whether it is safe, and it sometimes falls down and kills several men at a time, and horses too. There they are most particularly liable to accidents.

3058. Have you, as a professional gentleman, endeavoured to devise any means by which those men might be rendered less liable to such accidents?—We have done all we could in that respect by keeping the works in as narrow a compass as possible, so that the men should be under what we call a green roof, that is, that the men should not have to go under coal that has been hanging a long time, but always to get it down as frequently as we can; but when the

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the trade is very bad, and there is not that demand for coal, the works cannot move on with that rapid progress that they do when there is a good demand.

3059. But if you were less avaricious, taking down a less quantity at a time, would not that be a more prudent mode of working?—I do not know that we could possibly arrive at a better principle of getting the coal, at least by post and threill, than we now have, unless by long work, and some persons have tried that; it is now in operation.

3060. Do you consider long work less liable to accident than post and threill?—Yes, far less liable to accident.

3061. Is it really more costly to the master?—Are you speaking of the thick coal or the thin coal now?

3062. The thick?—The long work principle of the thick coal never has been sufficiently tried to ascertain that. I should expect it would be attended with a great loss of coal in some respects.

3063. Do you think it would deteriorate the sample?—No, I do not think it would.

3064. Do you think it would improve the sample?—I think it would in some respects.

3065. Might not that be to some extent a compensation for the lost quantity?—No, I think not; I think the coal is now sufficiently marketable in its quality.

3066. Now suppose that you would get 80 per cent. by post and threill, what is your own calculation as to the result that would be obtained from long work?—I do not think you would get that by long work.

3067. Do you think there will be any great difference?—No, I do not think there will.

3068. Do you think men would demand more wages for long work per ton?—No, I think not.

3069. Then you, as a professional gentleman, must be anxious to see the experiment fairly tried?—Yes, I am very anxious indeed to see it tried.

3070. Have you any idea of the number of lives that have been lost by the falling of coals in mines, in any given number of years?—No, I have not, except in looking over the reports of the coroner. I believe the coroner does not attend to the loss of life on all occasions in Staffordshire, from accidents by falls of coal; but in looking over the reports, and taking accidents in general, I have considered about two a day above and below ground; but how many there are below ground I cannot undertake to say.

3071. You speak of the county of Stafford?—Yes.

3072. Then the loss of life is about 600 per annum?—Yes, in that case it would be about 600 per annum; but they are not all in the coal mines, many occur in the iron works and other places. There are a great number of people drowned in the canals and children burnt to death, and all these varieties of accidents.

3073. You include the whole working population employed in the mining district?—I have seen the coroner's report, it is reported every week in the newspaper, but I have never taken out the number, I never have had the opportunity of doing it, so as to ascertain it; if I were to do it, it would not be correct, because there are many lives lost that do not come under the investigation of the coroner and an inquest.

3074. How does that happen?—It has never been the practice.

3075. You do not at all know what proportion of the 600 have lost their lives in the colleries?—No; but there would not be any great proportion.

3076. Then am I to understand you to say that when these accidents happen they do not generally fall under the investigation of the coroner?—Not when it is occasioned by a fall of coal in the pit. If an accident happens by a man falling into the pit, or by a rope breaking, or anything of that kind, or burnt to death, then it comes under the investigation of the coroner; but when it happens by the fall of coal in the coal mine, it frequently does not.

3077. But is there any special reason assigned for that?—I know of no reason, only that it has not been customary.

3078. Then if a workman were by wilful carelessness to thrown down coal without warning his foliow workmen, there would be no opportunity of bringing that man to justice?—There is an opportunity of doing it, but it has never been the practice.

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3079. Are those accidents of frequent occurrence?—Not frequent, but they do occur.

3080. Then any returns made by the clerks of the peace to the House of Commons can furnish no correct deduction of the amount of accidents?—I do not think it would contain the whole accidents that occur in coal mines.

3081. Do not you think it would be expedient, if there was the power of legislating with facility upon the subject, that the coroners in their returns should state precisely the nature of the accident, agreeable to the finding of the jury?—I think he should; but as I said before, it has not been the practice.

3082. You are aware perhaps there is a Bill for regulating the duties, &c. of coroners throughout England and Wales, before The House of Commons?—I have heard of it, but have not seen it.

3083. Do not you think it would be an essential provision to require that these returns should be made out more carefully, and with more discrimination as to the nature of the accidents?—Yes, I think it would be very proper.

3084. Now, have the coal-owners in your district offered any premiums for improved plans of working?—I am not aware that they have.

3085. Are the men very difficult to train in new methods of working?—They have got their prejudices against any new systems, but I believe that the men would comply with any reasonable request made by their masters, as far as lay in their power.

3086. Are they in any trades' union with you?—I think some of them are, but I do not believe that it is general.

3087. Not to such extent as to interfere with the economical arrangement of your concerns?—I think not.

3088. Do you think it is spreading?—Amongst the miners I do not think it is; I think it has seen its height; I believe it is rather going the other way.

3089. What wages can a good workman make weekly in working the thick seams?—If he is a pickman he will make 4 *s.* a day in about six hours; five to six hours, sometimes in four hours.

3090. In thin seams what will he make?—About 3 *s.* 6 *d.*

3091. In the same number of hours?—From four to five, six, seven or eight; it depends on the strength and dexterity of the man, and what is his power and ability; some men will require 12 hours, others will do the same work in six hours. Sometimes they do two days' work in one.

3092. Generally speaking, do you find your pitmen careless and reckless as to danger?—They are a little hardy in that respect; in general they are not very particular.

3093. Would you go so far as to say they are actually careless?—In some instances they are very careless indeed; in other instances very particular.

3094. Have you adopted any means, in order to correct that extent of carelessness?—Whatever carelessness there is, is chiefly where their own lives only are in jeopardy; it is with themselves, not where it endangers the lives of their comrades.

3095. But have you taken any means to make them aware of the consequence of that carelessness, or to prevent it as much as in your power?—Remonstrances are frequently made by their fellow workmen, as well as by the overmen employed, but it has not always the desired effect.

3096. Have you ever adopted any course of privation or punishment?—No, never in Staffordshire.

3097. Never tried that at all?—No, never.

3098. Do you let your work by the piece to gang-masters?—Always by the piece.

3099. One man undertakes the employment of a considerable number?—One, two or three, generally two, of the whole pit.

3100. Are they left entirely to their discretion, as to the mode of taking down the coal, provided they do not interfere with the general arrangement of the mine?—They are in some cases, but not in all cases, they are restricted in some cases; in some places they are better overlooked than in others; but as a general principle in most mines, the charter master, as he is called, is allowed to get the coal down how he pleases, so that it does not interfere with the coal itself, to waste the coal.

3101. Can you sufficiently rely upon the scientific knowledge and humanity of those charter masters, that they will not unnecessarily expose their men to danger?

danger?—I think they will not; they are a set of men who are very respectable in their situation, and they never would expose their men. They would not send a man where they would not go themselves.

3102. Is not their gain in proportion to the quantity that can be got out in a given time?—Yes, it is; but they cannot get more out than they have demand for in the market. The pits are seldom pressed beyond their proper bearing in that respect.

3103. Do they not pay their men in many instances by the day?—Yes, what are called the bandmen are paid by the day. The stinted men are paid by the yard.

3104. Then is it not to the interest of those charter men to get the coal out with as much rapidity as possible?—I will explain the difference between a bandman and a stinted man, if you please. After the stinted men have got down the coal, and brought it from the solid mass into a large heap of coal, then it is that the bandmen go with skeps and horses, &c., and fill it and haul it away; that is all they have to do. Those are called the bandmen; the others are called the pickmen, who are employed to get the coal from the solid roof, and I think that they undergo the greatest danger.

3105. Now do these falls of coal overtake the bandmen?—Yes, they do sometimes.

3106. Who warns them of the danger of a pillar of coal about to fall?—Nature itself; which is the best agent that can be employed in that respect.

3107. Will you describe what you mean?—When a piece of coal is about to fall, it makes a low crackling noise, just like the gentle noise of breaking a stick. Little pieces of coal, called the forerunners, are generally heard to fall. The person who first hears the notice, (and their ears are very quick,) cries out immediately "listen," and everything is perfectly still, there is a death-like silence instantly, and if the crushing of the coal continues they withdraw to a place of security.

3108. Can they always withdraw into a place of security, then?—Always into a place of security.

3109. Then, if there is invariably this warning, it follows as a consequence that any person caught by the fall is the victim of his own neglect?—I cannot say that the word "invariably" should be introduced, because there is no rule without an exception; sometimes a face or slip sets in, which cannot always be seen. This being a dislocation, will sometimes fall down without notice in the first instance, and accidents more commonly arise from that circumstance than from anything I know. But the general breaking of the coal, from its own weight in supporting itself, either after it has been cut or from any other cause, is attended with that natural cringing that I have described; and that very thing has saved the lives of thousands, and I might say tens of thousands of workmen.

3110. Now, what quantity of coal should you suppose, on an average, is brought down in one of these falls?—The ten-yard coal consists of layers of various thickness, as shown in the printed plan; they are divided in some instances by thin films of schist, and in others by thick partings. It is usual to cut through one seam at a time, and bring that down; if 10 yards square and three feet thick, it would be just 100 cubic yards of coal, or nearly 100 tons.

3111. Now would not four stiff props, to be drawn at leisure, prevent that mass falling at any time, at the required moment?—No; I think that timber cannot be applied in working the thick mines, unless it is in the lower part, and it is not there that accidents so frequently happen; it is in the upper or top coal. Only conceive a seam of coal 10 yards thick (30 feet); there are very few sticks of timber that could support 10 yards square of thick coal, they could not be taken into the mine of sufficient length to combine portability with strength. I think that timber never can be used with success in the upper seams of the 10-yard coal.

3112. Do not you think that struts elevated by a windlass might sustain the coal in a situation, if the base were removed so far that the experience of the workmen would indicate its fall as a matter of necessity, directly those struts were withdrawn?—No, I think not; not in the 10-yard coal. We have a better plan than that; it is by leaving what is commonly called a man-of-war, that is, a small intermediate pillar, which is employed to hold the upper beds till it is

necessary to bring them down; they are sometimes called steadies, and are used particularly where faces and slips prevail in the coal. We excavate the bottom part in the first instance, and then discover the slips and the angles they make; and we contrive to leave a man-of-war so placed as to prevent their annoying the workmen when the coals are wrought in the upper seam. Finally, the men-of-war are taken out.

3113. Is not that a dangerous operation?—No, I think not.

3114. Does it never bring down a portion of the roof of the mine?—No, not in taking out a man-of-war, it very seldom happens. But accidents will happen in everything. It is impossible to work mines in any way without being liable to accidents. Those who ride on the tops of stage-coaches are exposed to them, as well as in all ordinary affairs of life. But in speaking of it as a general maxim, I think timber never can be used in getting the 10-yard coal by post and threill, where the whole thickness is got together.

3115. And in long work, as you have already stated, the risk is very much reduced?—It is always used in long work, more or less; the wood must be good for it to be used, but they are short props.

3116. Have you known any explosion in the thinner seams?—I have known some trifling explosions.

3117. But no fatal ones?—Yes, I believe some have been fatal.

3118. Do you ventilate your thin seams on the same principle practically as the thick seams?—No, we do not. We ventilate them upon a different principle; our long work system is by carrying out two headways, we unite them with what is called a *navvy*. Every mining district has a different name for the same thing; that is, by threiling two gateways, and we carry that the whole length from one side of the pit to the other generally, and thus ventilation is carried on through the medium of those navvies. The gas is not in our thin seams so common and so considerable as it is in the north of England, we have not the same difficulty which is described to exist there.

3119. In point of fact, many of your seams have no quantity of which you can complain?—No, they have not.

3120. Do you always drive to your boundary before you commence coal work?—We generally begin in the deep, and work from the deep upwards. The deep of our boundary, if it is practicable, we always go to the deep; and by that means the water is left behind, and we work up towards the crop of the mine in all cases.

3121. Then you pump water on the dip of the whole mine?—Yes, that is our principle.

3122. What is the extent of coal you will take by the ordinary means, in yards?—Are you speaking of the thick or the thin mines?

3123. The thin mines?—You observe by the plan I have laid upon the table, that our pits are seldom more than 300 yards apart, commonly 150 or 200, and we take from pit to pit, and they ventilate each other. It makes a complete system of ventilation by the pits being so numerous on the ground.

3124. Then you circumscribe 800 or 900 square yards of coal on each shaft?—Yes, we do; very seldom more than 10 acres; the plan states 15 acres to each pit.

3125. What size are these drifts, what breadth in the thin coal where you ordinarily drive your drift?—About five feet;four to five feet.

3126. Do you employ one man or two in driving those drifts?—Generally two.

3127. Is it continuous work day and night, the process of driving?—We sometimes drive night and day, but it is not very commonly the case.

3128. How many yards will you advance in 24 hours with continuous work, supposing there are three sets working eight hours?—We seldom practice eight in drifting, generally twelve.

3129. Supposing there are two sets 12 hours, and the drift is five yards wide, how many yards will that drift progress in the course of 24 hours?—About two yards.

3130. Then, in drifting this course, how do you supply the mine with air while the drift is proceeding?—[*The witness described the way it was done.*]

3131. Then in point of fact the drift that is so driven, is merely for the purpose of laying down the mine to advantage?—Yes.

3132. And

3132. And not for the purpose of ventilation?—It is for both in that case.

3133. But not considered material as a point of ventilation?—Yes, we are obliged to do that.

3134. How do you supply yourself with air in the progress of sinking and laying out the mine?—I have driven out roads 150 yards without artificial ventilation.

3135. Of course you carry the air with you?—Not always. In some instances in driving a road of 150 yards out, when everything has been cool and quiet, the workmen and horses having retired, and the air has been allowed to find its own course, by putting a candle at the bottom of the road, I have noticed the bias of the flame towards the extreme point of working; by raising it up into the centre of the road, the flame has been upright and without bias, as if nothing disturbed it; by raising it to the roof, which is about six feet high, the bias has been the contrary way; and yet there is no connexion with any other mine by which that system can be accounted for; it is the system of nature; the cold air coursing along the bottom, and the warm air retiring along the top. I have many times seen that.

3136. What is the thickness of the bed of coal to which you are alluding?—About eight feet.

3137. Are there any other accidents, such as the breaking of ropes or chains, which your men are subject to?—Yes; I have known accidents in a thousand different ways, where they were least expected, from a variety of causes which it is impossible to recollect; but accidents of different descriptions are very frequent about mines and iron works, and such like. Staffordshire is a great country for iron works.

3138. What are the risks attendant on miners in ironstone mines?—The ironstone mines are not so subject to accidents as the coal mines are.

3139. In what thickness are the veins of ironstone generally found?—The measures are generally of the thickness of about three or four feet, and the ironstone from one to 15 inches.

3140. Would there be any difficulty in ventilating those mines?—None whatever.

3141. Does the ironstone fall in detached masses?—It falls the same as thin coal does when wrought long work; most of it is wrought long work. The face of work is generally of considerable length, and holed under, to give liberty for the pressure of the earth to pinch the top, and thus bring it down without much manual labour, by taking a long length; but if it is confined to a short length, manual labour or blasting powder must be used.

3142. I think you have stated that you are acquainted with almost all the coal mines in Staffordshire?—Yes, I am.

3143. And you think that there are none of those mines so infested with foul air, but that moderate precaution might naturally prevent accidents from explosion?—I think it might.

3144. That if any Honourable Member should hereafter see the account of six or eight men losing their lives in one of these mines, they must lay it to the account of accidental circumstances, rather than to real danger resulting from the working of those mines?—If the mines are carried on and conducted in a proper scientific manner, I believe he might: that is my opinion as a mining engineer.

3145. Are you acquainted with the principle on which Mr. James Foster is now working his mines?—That is the principle of long work.

3146. He is working the thick mine on that principle, is he not?—Yes, he is. I have not seen it; that is what I am very anxious to see, and to know whether he succeeds in it: it is near Kingswinford.

3147. You are not then aware whether it is likely to be successful or not?—I am not at present aware of it.

3148. You said that it was not the practice for the coroner to take cognizance of all accidents in mines in the neighbourhood of Dudley?—Not in all cases; I have known a great number of cases of which no notice whatever has been taken. I do not know whether he is now more particular than he used

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to be; but certainly, through my life, up to within a very recent period, he did not take cognizance of all.

3149. Are you acquainted with the practice in that respect in any other parts of Staffordshire?—No, I am not.

3150. Are you aware that accidents happening in mines always come under the cognizance of the coroner in the neighbourhood of Newcastle-under-Lyne?—I am not at all aware of that. I wrote down a little explanation, which perhaps the Committee will allow me to put in.

3151. Can you favour the Committee with an outline of your description of the system pursued by you in ventilating and working your mines?—Yes, I have put it down here in a very few words; compressed it as much as possible, just giving an explanation of the plan I have pursued; but it is much the same as what I have already described.

3152. Does it contain any particulars over and above what you have generally alluded to?—It may contain some, because it explains the plans, and it explains a little of the mode of working.

3153. Does it explain the plan which you have delivered in to the Committee?—Yes, that is all that it does explain.

[*The paper was handed in, and is as follows*:]

"Description of Nine thick Coal Pits, scientifically arranged to succeed each other in their proper working order, and so as to guard against breeding Fire and inflammable Gas.

" A, B, C, D, E, F, G, H, I, represent the pits severally. Each pit has four square of work allotted to it, numbered 1, 2, 3, 4, &c.: thus, squares 17, 18, 19, 20, belong to E pit. The roads which extend at right angles from pit to pit are called the mother-gates; the ribs of coal in which they are formed are called the mother-gate ribs. The shaded ribs of coal, through which no roads are made, are called division-ribs, and separate the sides of work of one pit from those of another. The fluted ribs are called fire-ribs, and separate the sides of work from each other in the same pit; they are intended to stone up and extinguish the breeding fire when it appears. Each side of work is distinguished by figures of the same number placed upon the pillars. Some of the squares have five sides of work, some six, and some seven, according to circumstances. The pillars are 10 yards square each, and the squares around each pillar not coloured represent the coal got or intended to be got. The small roads which extend at right angles from the mother-gates into each side of work, are called way-gates, and answer for water-gates also, unless under-drainage is necessary. The double red lines represent fire-dams, by the use of which each side of work is closed up as soon as finished. The single red lines are air-doors, to direct the air-courses from time to time, as may be necessary. There is no rule for placing them, except that the safest situations are generally chosen, and they must be erected where their object can have the desired effect. The short lines which cross the mother-gate ribs are bolt holes, and are made to suit the convenience of the charter master, in getting the coal away from different parts of the sides of work into which they enter. The large blocks of unbroken coal around each shaft are called pit eye pillars, and are intended to protect and secure the shafts. Every side of work is ventilated by means of top-heads driven into the upper part of the top coal. The top-heads always accompany the mother-gates and way-gates in mines subject to inflammable gas, and conduct the returned air to the upcast shaft, so that neither horses nor miners are ever exposed to it. The top-heads are not shown in the plan, because they would interfere with the mother-gates and way-gates, they being nearly over them, and always accompany them in gaseous mines. The plan is drawn to a scale of 20 yards to half an inch; and every small square contains 100 superficial square yards, or 1,000 cubic yards, supposing the coal to be 10 yards thick. Each pit is supposed to get about 15 acres of coal, more or less. The dip of the coal is supposed to be to the south, but considered to be nearly a flat mine.

MINING results of Pits D & E.

Pit D. No. 14 Square.

Five sides of work. First working.

	Squares.	Per cent.	Per cent.
Pillars	16		
Fire ribs	34		
Division ribs	12		
Mother-gate ribs	18		
	80	= 46¼	
Excavated	93	= 48¾	48¾
	173		
Roof coal and benches	5		
	100		
Second working			20
			68¾
Total waste			31¼
			100

No. 16 Square is the same as No. 14.

Pit E. No. 17 Square.

Seven sides of work. First working.

	Squares.	Per cent.	Per cent.
Pillars	17		
Fire ribs	46		
Division ribs	13		
Mother-gate ribs	20		
	96	= 47½	
Roof coal and benches	5		
Excavated	106	= 47½	47½
	202	100	
Second working			20¾
			68¼
Total waste			31¾
			100

Pit E. No. 19 Square.

Six sides of work. First working.

	Squares.	Per cent.	Per cent.
Pillars	19		
Fire ribs	41		
Division ribs	13		
Mother-gate ribs	20		
	93	= 46	
Roof coal and benches	5		
Excavated	109	= 49	49
	202	100	
Second working			20
			69
Total waste			31
			100

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Pit E. No. 20 Square.

Seven sides of work. First working.

	Squares.		
Pillars	17		
Fire ribs	46		
Division ribs	13		
Mother-gate ribs	20		
	96	= Per cent. 47½	
Roof coal and benches		5	Per cent.
Excavated	106	= 47½	47½
	202	100	
Second working			20½
			68
Total waste			32
			100

Dykes, faults, slips and faces, and soft tender coal, will not produce so good a yield. The gob or goaf-heap is larger, and breeding fire more troublesome, which renders the second working less advantageous.

3154. Are there any further papers you wish to hand in?—No, I have nothing more than notes and calculations; I did not know what questions might be asked.

3155. No allusion has been made in your examination to the safety lamp; has that been an object of interest to you as a professional man?—Yes, I think the safety lamp has been exceedingly useful in mining, ever since it has been introduced.

3156. Have you had any opportunities of judging of its value?—Yes; it did away at once with the necessity, I was going to say, of the firing line, but that was not the safety lamp, it was the top-head that superseded the firing-line.

3157. The plan proposed by Mr. Ryan?—Yes; the safety lamp enables us now to complete our threiling when we are carrying on particular openings in the works, or uniting one work with another; we have not the means without a great expense of carrying out air, and whilst the workmen experience little difficulty, the use of the Davy-lamp enables us to do work that could not very well be done without it.

3158. Then, in point of fact, its value to you is as an occasional instrument rather than as a working implement?—Yes, that is all; we do not use it as a working implement.

3159. Have you performed any experiment with the lamp?—No.

3160. Have you ever known any accident with the use of it?—I never have, directly.

3161. Do you use the lamp as originally constructed by Sir Humphrey Davy?—We use it as it was handed down to us in the first instance by Sir Humphrey Davy in a plain manner.

3162. Do you keep it locked?—No, we do not.

3163. Do you know any instance of workmen playing tricks with the lamp?—I have never known an accident arise from anything of that kind by workmen playing tricks, or anything of that sort.

3164. Do you allow your men to smoke in the mine?—They do sometimes.

3165. Do you ever hear of any one of them drawing the flame through the gauze, for the purpose of lighting their pipes?—No, I do not think that any man in Staffordshire would do such a thing, or use a pipe when he was aware that there was the presence of gas.

3166. You think the overmen, or those to whom the lamp is entrusted, and who are quite aware of the danger, would prevent such experiments?—I think most of them, if not all.

3167. Do not you conceive it absolutely necessary that the men placed in trust, the overmen, or what are called in the north wastemen, should thoroughly understand the principle on which the lamp is supposed to act?—I think

I think they should; and if lectures upon it were instituted throughout all mining districts, it would be an excellent thing, or explanations given, for most of the workmen now, not all, but most of them can read since the establishment of Sunday schools, and any explanation of that sort scientifically drawn up would be a very useful document.

3168. And printed and distributed annually among the workmen?—Yes.

3169. Now, would it be possible to add to such an exposition of the merits and advantages of the lamp any general rules for taking down the coal, which you have instanced as attended with such frequent calamities with you?—There is no harm in suggesting any mode, and particularly any new plan; and when it comes before the public, the attention of so many individuals being directed towards it, they would soon, I think, discover whether there was any merit in it, or anything new by which they could improve the system already in practice; if they could, they would be very glad to adopt it; if not, they would remain as they are.

3170. But the question referred to the expediency of a concise form of stating to the workmen and reminding them of the points of risk; do you think they are already sufficiently aware of what those points of risk are?—I really think they are in that part of the country. There are some men who will never believe there is danger till accidents happen, although often warned against them to the moment of their occurrence. There are some fool-hardy men who will run into danger, although they may suppose themselves to be lost the next moment; swearing fool-hardy men; but it is not a common thing. the men are very different to what they were 20 or 30 years ago; they are more intelligent.

3171. Are they not very much averse to adopting new principles?—Yes, but not so much so I think as they were; I think if a new principle were to be introduced, and well thought of by the masters and leaders, and they were to speak favourably of it, I believe there would be no difficulty as regards the men in introducing it. The difficulty in general is with the charter-masters, who wish to know what they are to get by it; if they are to get nothing, they do not like the trouble of attending upon it; but if they are to gain by it, they will soon introduce it into practice. Some men are quicker to comprehend a new principle than others, and show much more readiness consequently in adopting it.

3172. Have you any Mechanics institution or Polytechnic schools in your district?—Some few have been lately introduced, but not immediately in the collieries, there are some at Birmingham. I am not sure whether there has not been one introduced at Dudley lately.

3173. Are they patronized by the mine proprietors and their agents?—As much as possible, I think.

3174. Do not you think that it would be one means of inducing specific observation and drawing out native talent, to offer premiums in such institutions for the best means and safest methods of working coal mines?—Yes, I think it would be an excellent thing.

3175. Are you aware of the existence of a Polytechnic school in Cornwall with that object?—I have heard of it, but I know nothing of the particulars.

3176. Are you aware that it has been stated that it meets with very great encouragement, and promises to be of the greatest possible utility?—Yes, I have understood so; I should think it would be an excellent institution.

3177. And that it is extensively patronized by the nobility and mining proprietors generally in that district?—I believe it is.

3178. Might it not be of great advantage if men of science, chemists for instance, and mechanics, could be induced to visit mining districts, and make observations on the spot?—Yes, I think it would be very useful, and I should be very glad to see it; as far as I know anything of the mining districts, or the concerns in which I have been engaged, their presence would be courted rather than looked coolly upon.

3179. Now the object of this inquiry is to endeavour to ascertain the extent and cause of the accidents that have occurred in the mines of Great Britain, with a view of suggesting remedies for those accidents; does anything occur to you to mention to the Committee, which has not been elicited in the course of the examination which you have so kindly attended to?—I consider that part of Staffordshire to which I more immediately belong to be under a complete

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system of ventilation, and that it is not necessary that any number of lives should be exposed to explosion, as I have already stated; but if you allude to any other part of the country, it is a different thing. There are a great number of mining districts not subject to gas, where there is no gas; and there are others that are so.

3180. The question would naturally lead you to state whether any system is pursued by you, unattended by loss of life to the workmen, than what to your knowledge exists among your neighbours?—No, not in Staffordshire, I think. The principle is become now so generally adopted by all parties, that we are very nearly one and all alike. Some persons perhaps, when there is very little gas indeed, may wish to avoid expense in working their mines, and may neglect to carry their air-heads as far as they ought; in that case their workmen may be subject to more danger, and I should not be surprised if that circumstance were to account for the loss of some of the lives before alluded to.

3181. Is that upon the principle that you think the air-head draws off the explosive gas from the lower one?—Yes. I do not think that inflammable gas is unmanageable. I think it capable of control in most if not in all mining districts, so as to be less injurious to workmen than heretofore.

3182. Have you been in the principality of Wales?—Yes, I have.

3183. Are you acquainted with the mines in North or South Wales?—I have been in both North and South Wales.

3184. Have you descended the mines?—I have descended the mines in North Wales, but not South Wales, except the adit-mines.

3185. What part?—In the neighbourhood of Ruabon. I have never been in the mines at Flint and Bagilt, although I have been at those places.

3186. Did the mines in the neighbourhood of Ruabon appear to be well ventilated?—What I saw of them at that time, which is now many years ago, appeared to me as far as their working went, for the pits were rather numerous, that they were sufficiently so. I was not aware that they were otherwise; it is now nearly 20 years ago.

3187. Have you visited any mines in the neighbourhood of Newcastle-under-Lyne?—Not to descend them, I have not, excepting in one instance, and that was one of Lord Grenville's mines, near Handley; but it was not to investigate the system of ventilation. I heard Mr. Forrester give evidence here upon that very pit.

3188. Then you cannot say whether they are worked with due reference to the security of the mine?—No, I cannot; I cannot speak to it positively.

3189. Do the men require greater wages when they are working by the lamp in your neighbourhood?—If we had to use the safety lamp in all cases of working, I think it would be the means of increasing wages very much; because our men, particularly in the thin mines, have to lie down, and work in that position to undergo the coal; and the further part of the holing is only as high as the point of the pick is wide, so that it would be very difficult to place the safety lamp where it would give light to the workman, and unless the light is reflected on the very place where the pick strikes, the workman cannot direct the instrument with effect; he has the candle upon a piece of clay, so that he can place it anywhere at pleasure, and thereby direct the light to the spot where execution is required, whereas the safety lamp must be placed in a vertical position. If it were placed obliquely, danger would attend it; and although there might be a sufficient kerf in the holing or underworking of the coal to place the lamp erect, yet it could not be taken within two or three feet of the back of the holing, particularly where it was four feet from the face of the wall, and the dim light of the lamp would be of much less service to the workman than the light produced by a candle, and thus he would be subject to much loss of time. I am certain it would be the means of causing a great addition indeed to the workman's wages. The true principle of working mines will be found to be that of efficient ventilation; and my opinion is, that you never can work coal seams any other way so properly and profitably as by keeping the men always in a safe and healthy atmosphere.

3190. You mean, I suppose, to include the mines about West Bromwich?—The West Bromwich district, what we call the explosive district, in connexion with Dudley, all about there. They all adopt the same principle.

3191. Your general remarks as to the quantity of gas, and the mode of working, will apply to that district?—Yes, to that district.

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John Murray, Esq., called in; and Examined.

3192. WHERE do you reside?—At Hull.

3193. What is your profession?—A lecturer on chemistry.

3194. You have also given scientific lectures, I believe, in different parts of the country?—I have.

3195. Has your attention ever been pointedly drawn to the difficulties and dangers which attend coal mines, owing to the presence of the different noxious gases?—A good deal.

3196. Have you applied your mind to the subject with reference to ventilation generally, or to the means of providing a secure light?—To both, I believe.

3197. Will you state your views, as a scientific man, on the subject of ventilation?—It is, I think, evident, that in reference to the phenomena of fluids, that there are two distinct currents, while the centre remains quiescent. This appears very evident on presenting, for instance, a candle in the door-way; a lighted candle; it would be observed that the flame of the candle is carried out from the room from an out-going current above, and the reverse will take place at the threshold or floor, while the intermediate portion will be entirely quiescent. I believe that will apply to water. I have been so informed by persons who have gone down to considerable depths, that there is a current moving below at the bottom of the ocean, for instance, in a different direction to the current moving above, and the intermediate portion is entirely quiescent. From that I would learn a lesson in ventilation, and would therefore apply tubes; what I may term a system of tubes; one connected with the roof, to carry the heated air from the superior aërial stratum of the mine (of the gallery), and the other to bring down a current of heavy air to replace that. But in order to accelerate that ventilation, I should have the upper surface of the tube connected with the roof of the mine, entering a brazier of ignited coke or charcoal. This, however, I would arm against occasional explosion, by several folds of wire gauze; and I think, too, it might be advisable to have a forcing-pump on the principle employed by Mr. Deane in diving, connected with the tube which is to supply the current of fresh air. I consider that in the present system of ventilation, great danger arises from the air moving in that central direction, and thus, by agitation, forming an explosive mixture; for the gas being specifically lighter, would naturally ascend to the roof of the mine. I have seen it there ignited, forming a continuous sheet of non-explosive flame extending along the roof.

3198. Then you consider the present system of ventilation imperfect in the way you have described?—I certainly do; and I think that this plan would be a great means of rescuing those who fall victims to the after-damp, because the carbonic acid or the choke damp, that fills up the vacuum occasioned by the explosion, necessarily proves fatal to those who happen to survive the explosive shock.

3199. But you are aware that in these explosions the interruption of the ventilation is so universal that no air whatever, in many instances, can penetrate the mine, or those sections of the mine which have been affected by the explosion; in which case, would not your system, like all others, be substantially deranged?—I think not; because by the simple application of the forcing pump, fresh air would be impelled down the descending tube.

3200. But if the tubes were filled by falling matter, such as fragments of coal and stone, your force-pump would be unavailing?—I should imagine that that could very seldom occur.

3201. Do you think there would be force sufficient in a tube of comparatively small diameter?—I should think so; besides the action of the force-pump is very great indeed, and would, I think, expel anything that had entered the orifice.

3202. You are aware that the mass of debris is so great, that it requires many men, days and weeks frequently, to clear a passage for even one man to penetrate through what now may be considered as the air-course?—I am aware of this; but having orifices here and there, I presume that, if the orifices were small, the debris would not enter them, and it could be easily expelled by the action of the forcing-pump; or we might also propel through that pipe a quantity of water, which I have found invariably to resuscitate inferior animals

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in asphysia from choke-damp. My experiments have only been made upon such as had perished victims of carbonic acid, or after-damp.

3203. Do you propose to carry metallic piping from the top of the shaft to the most remote parts of the work, which is generally the point of danger?—I should employ what is called Hancock's elastic or Indian-rubber tube.

3204. And where would you insert those pipes; what part of the mine?—I would connect this tube with the floor of the mine, and extend it to the farthest extremity of the working, wherever that might be. It is so very flexible, that it could be easily bent in any direction, and carried to any part of the works.

3205. It would necessarily have to pass down the shaft?—Yes, it would have to pass down the shaft; and at the top of the shaft to be connected with the force-pump.

3206. Are you not aware that everything in the shaft is entirely blown out on the occasion of an explosion?—Yes; but the tube might be inserted into the wall of the downcast shaft.

3207. It might in fact pass behind the brick work forming the shaft?—Exactly; and be imbedded, for that matter, in the lower part of the floor of the mine, and I take it very little debris could at all interfere; and we could certainly accelerate the ventilation very much by connecting a second pipe to carry off the heated air and the lighter gas from the roof also; and by connecting that moreover with the brazier of ignited coke, you would, I think, render it independent of the force-pump. It is generally sufficiently powerful to ventilate a mine.

3208. This you suggest as an expedient in case of accident, rather than to be constantly in operation?—Constantly in operation. The comparative expense I do not know: I believe this tube costs about 1*s.* 6*d.* a yard; at least from 1*s.* to 1*s.* 6*d.*, according to quantity.

3209. Of what diameter?—Of about an inch diameter.

3210. Well now, if 50,000 cubic feet of air are required minutely for the ventilation of a mine, how would your apparatus answer?—I should conceive tolerably well; the diameter might, I presume, be easily calculated.

3211. Can you off-hand state what sized tube would be required to discharge a volume of 50,000 or 60,000 cubic feet of air minutely?—No, I could not; the mines are very different with regard to the quantity of air moving through them. I am merely calculating upon the process of natural ventilation, and I conceive that the present system is erroneous, because those stoppings and trap-doors allow that central quantity of atmospheric air which is generally quiescent to be disturbed, and by that means the ascending fire-damp mingles with that which otherwise would be quiescent, and forms an explosive atmosphere.

3212. Are you not aware, that in particular states of the atmosphere, the gas comes pouring out of every orifice of the coal with considerable force, as water would out of a watering-pot?—Yes.

3213. And that it necessarily mixes with the current of air from these blowers, which occasionally extends to many feet?—I would not confine myself entirely to ventilation; I would endeavour to consume the fire-damp by an aggregation of safety lamps, suspending them from the roof of the mine. The gas would necessarily ascend, and it would then be consumed. The result of this combustion would also be attended by the formation of a quantity of carbonic acid, as well as insulated azote, and it is known that those two gases, when mixed with an explosive atmosphere, tend to disarm it of its explosive powers.

3214. But now, with respect to pipes; the working of a mine by either galleries with large pillars, or a waste naturally voided of the coal, the whole of the galleries among these pillars, and the whole of this waste, the roof and the floor, are at the same time pouring out a constant stream of gas, less or more, in different parts: your tubes must necessarily follow every winding of that work, must they not?—I conceive that the orifice of the tube would be a kind of focus or point where the gas from every quarter would collect, and entering the orifice of this pipe, be discharged.

3215. Are you aware that the pipes or air-courses in some of the mines which are liable to these terrible accidents in the north, extend through a distance of 30 miles?—I am. Perhaps this may not apply to every case.

I have

I have not made the calculation, but the two together might; but the expense may perhaps exceed what would remunerate the proprietor.

3216. Having referred to a number of safety lamps, do you, as a scientific man, consider Sir Humphrey Davy's lamp to be emphatically a safety lamp in all cases?—No, I certainly do not; that is, not in all cases.

3217. Will you give the Committee your opinion on that subject, as the result of experiment or theory?—As the result, I should say, of direct experiment. I have no doubt that very many accidents have occurred with Sir Humphrey Davy's lamp, that lamp not being absolutely safe, igniting an explosive atmosphere. Of course I do not wish to enter into the theory, for I happen to differ with scientific men generally, and I would rather confine myself, if you please, to practical results. The accidents from the lamp, I conceive, are in the first place to be ascribed to the mere occasional use of the lamp. Taking it, for instance, as an exploring lamp, and suddenly encountering an explosive atmosphere, or perhaps passing a blower, the sudden entrance of an explosive atmosphere into the lamp would ignite it almost immediately, and I should think kindle the gas; in my experiments it has kindled the gas, by making the lighted lamp to transit, for instance, a jut of carburetted hydrogen; for it has passed through the lamp and ignited the gas at the orifice.

3218. Now in that case, what was the estimated velocity of carburetted hydrogen taken in feet per minute?—I did not estimate exactly that, but I should conceive it to be not moving with any great velocity, certainly not so much as I have often known blowers to emit gas.

3219. Can you give an idea whether it was at the rate of 300 feet or 400 feet or more per minute?—I should think less than 300 feet.

3220. You think that pure carburetted hydrogen passed through the gauze of a lamp, will ignite it beyond the gauze; that is to say, impelled against the lamp, the flame will break through: 300 feet per minute would not be above three miles an hour walking, would it?—Not above that; of course that will depend, you know, necessarily on the size of the meshes.

3221. You are now speaking of the standard gauze, or the gauze approved by Sir Humphrey Davy?—Yes, it is that I advert to.

3222. Then, if a man were walking through a very explosive mixture with his lamp unprotected, at the rate of three miles per hour, and the current of gas was setting towards him also at the rate of three miles per hour, the mean resistance of the gauze being four miles per hour, should you anticipate an explosion as a natural consequence?—I should.

3223. Should you have any doubt as to an explosion taking place?—Not at all, because the flame is then impelled against the side of the gauze, and it acts then with all the impetus of a blow-pipe on that side. It is that which enhances the tendency to explosion.

3224. This would be a practical experiment, confirming those which you have made as a man of skill?—Yes. There is another cause of accident with that lamp, which has not been alluded to. I believe I was the first that pointed it out. The indiscriminate use of copper and iron-wire gauze.

3225. Have you seen copper gauze in use in those lamps?—Yes, I have; and I have seen them exposed in the windows of ironmasters indiscriminately. I was the first who made the experiment which proved the danger of the copper safety lamp.

3226. Will you state what that experiment was. I made the experiment with the fire-damp in the Bagilt colliery in North Wales. The fire-damp burned green, and possessed the green tint which it received by the solution of copper. The explosive flame was in actual contact with the copper tissue, which when dissolved in the fire-damp, communicated a green tint to the flame within; a sufficient proof that the copper was dissolved.

3227. Did you continue that experiment sufficiently long to ascertain what length of time would be required to oxydize the whole substance?—No; I did not continue it sufficiently long, but I am in the habit of repeating it for illustration. I suppose I have made the experiment more than 100 times; and to prove it, we have only to immerse slowly a copper safety lamp in a portion of the vapour of ether mingled with atmospheric air, and will then find the whole cage full of a green-tinted flame; and, moreover, that the flame is in evident contact with the wire gauze itself.

3228. Is the vapour of ether a natural combination of carburetted hydrogen?—I am

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—I am talking of the carburetted hydrogen entering into the constitution of the flame filling the cage and dissolving the copper tissue, and thus forming that green tint which is peculiar to a solution of nitrate of copper in alcohol when inflamed. The vapour of ether arises from a small portion of ether thrown into a large vessel, and when mixed with atmospheric air the lamp is slowly lowered into it.

3229. But is that a natural combination with carburetted hydrogen?—It appears that carburetted hydrogen always acts powerfully on copper tissues, and I have repeatedly proved the fact.

3230. Will you explain your object in making experiments with an infusion of vapour of ether?—I have merely adverted to that as an easy experiment of proving the same thing, because the vapour of ether is an inflammable vapour, and when mingled with atmospheric air, forms an explosive compound. I am, moreover, of opinion that M. Provôst has stated correctly that alcohol and ether are liquid combinations of carburetted hydrogen and hydrogen, so that I conceive it is an apt illustration of the same principle.

3231. And these experiments carried conviction to your mind that copper gauze would on no account be allowable?—Certainly not. I had once nearly lost my life with it, the copper being nearly dissolved in repeated trials; but when I found out what was the cause of it, by investigation, I repeated it seldom and not for a long continued time.

3232. Now, will you turn your attention to the iron-wire gauze?—With regard to the iron-wire gauze I differ in opinion as to the cooling influence to which it has been ascribed, because I believe the lamp is dangerous when it is cool.

3233. Perhaps you will give the Committee your idea of the *rationale* of Sir Humphrey Davy's lamp as explained by himself?—Flame in all cases whatever is to be considered as inflammable vapour or gaseous inflammable matter, heated above whiteness. The lamp simply acts by cooling that incandescent inflammable matter below the point at which it is incandescent, when it ceases to be flame. This is said to be a very simple explanation, but the question is, whether that explanation be correct.

3234. Now, will you compare that view of the case with the one you have been led yourself to form?—The way that I explain the lamp is this, and I am warranted in my conclusions by the experiments of Mr. Dillon of Belfast, irrespective of my own. Indeed I constructed a safety lamp proving the fact I am about to state. It may be mentioned that the fire-damp of the mine, when it forms from one-seventh to one-thirteenth part of the atmosphere, will explode, though beyond these limits it will not explode. If we mix a small portion of either azote or carbonic acid gas with such a mixture, it will no longer explode, or it will disarm it of explosion. I need not mention that the more highly concentrated an explosive atmosphere is made by condensation, the more violent will be its explosive effect when it is ignited. Now it occurs to me that, seeing the lamp is positively safe when it is heated, though unsafe when it is cold, the heated wire-gauze which confines the explosive flame within will enfeeble its power by attenuation, because if we attenuate or rarefy such a mixture, whether by the air-pump or by heat, it will not explode. I cannot see how any cooling influence could operate where individuals have worked for many hours with the lamp red hot, and I have myself had the lamp red hot from top to bottom, yet remaining safe. I have gone through an explosive atmosphere in a colliery in the neighbourhood of Paisley; I cannot therefore discover wherein the cooling influence of red-hot gauze resides.

3235. Do you attach no importance to the principle of external pressure on the gas preventing the flame passing?—I should conceive that it may have some influence; perhaps a great deal may depend also on that, but I cannot see what that has to do with the cooling influence to which the safety has been solely and exclusively attributed.

3236. But whatever mistakes may have been made in the principle of Sir Humphrey Davy's, do not you think that the most reasonable conjecture is that the pressure from without is sufficient to resist the passage of the flame externally?—It is an idea which has not occurred to my own mind, but I should conceive it may very considerably operate.

3237. Is not the consequence of the flame in the lamp to produce nearly a complete vacuum?—It will rarefy it very materially.

3238. And

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3238. And will not the pressure from without be increased in consequence?—But if it is more dense without, it would rush in by the meshes into the interior.

3239. You are aware the lamp is attached to meshes?—Yes.

3240. Do not you think that the pressure of the air inwards prevents the flame or the atmosphere in an inflammable state from proceeding out of the cage?—I think it highly probable it may very considerably influence the phenomena.

3241. But where the pressure on the opposite side of the lamp is neutralized by a blast through the lamp, does not the flame immediately pass?—Yes, I should certainly think it would.

3242. Is not that an easy explanation of the theory on which you have just been questioned?—I was merely mentioning the fact; the theory I will resign to you, as having, perhaps, accounted for it better.

3243. In what mines have you experimented with this lamp?—I have been in many mines, both in Scotland, Wales and England.

3244. You did not find much explosive gas in Scotland, did you?—No, not much.

3245. And much less in Wales than in the counties of Durham and Northumberland?—I have never been in the mines in the neighbourhood either of Durham or Newcastle at all. I am quite unaware practically of the phenomena there.

3246. Are you aware from report, that the explosions of gas in the coal seams of Durham and Northumberland are infinitely greater than what is known in any other part of the kingdom?—I have no doubt of that whatever.

3247. Then in your opinion ought the explosions which cannot be immediately traced to any defect in the lamp, to be attributed to the careless use of it?—I rather suspect that the workmen have often been blamed when they ought not to have been blamed. That is my own opinion from what I have heard.

3248. But what is your impression as to the ordinary cause of these lamentable accidents which are too well known to have taken place?—Do you advert to the accidents where the safety lamp has been in use?

3249. Certainly?—I conceive that it has been chiefly from using it as an exploring lamp, by means of which the current would be impelled, in traversing the mines, in the opposite direction; being an explosive mixture, it would act with all the force of a blow-pipe on the opposite side.

3250. Are you aware of any mine having exploded in the act of exploration?—No, I am not.

3251. Are you aware that the men using these lamps in exploring the mines, are always expected to protect their lamps with a tin plate to avoid the passage of the current, and that they carry the lamps close to their bosoms, thus preventing the passage of any current of air in the opposite direction to that which they are going?—I am not aware of that fact, and I rather suspect that is a very recent introduction.

3252. If it has been stated by a witness conversant with the practice that such is the case, do you not consider that those are wise precautions?—Unquestionably, every precaution is valuable that would prevent the action of the current.

3253. Then your opinion of the safety lamp not being a real and constant protection, applies to those times when it is used in a state of motion or ignition?—Chiefly so, because it is known they keep working with the safety lamp red hot for some hours together, in Earl Fitzwilliam's collieries, and I have been also told in the neighbourhood of Bradford, where a coal proprietor informed me of the fact.

3254. Have you any idea what length of time it would require to oxydize iron wire, assuming the cage to be continually filled with ignited gas?—No, I have not; but common oxydation may be prevented altogether on galvanic principles, by the attachment of ribbons of zinc.

3255. How would you propose to attach those ribbons?—Three of these bands might at certain distances surround the cylinder, and I would attach them by means of a proper wire to the copper lamp below.

3256. Do you mean no oxygenation would take place from very great heat?

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—I am not at all aware that carburetted hydrogen in ignition would oxydate iron.

3257. Are you speaking of carburetted hydrogen in its actual state, or in a state of ignition?—Carburetted hydrogen in a state of ignition.

3258. Have you descended those mines of Earl Fitzwilliam, to which you alluded?—No, I have not.

3259. From report, do you consider those very dangerous mines?—I do not think they are dangerous at all; I have not heard of many accidents occurring in them, and my authority is Mr. Biram.

3260. Have you ever considered whether it would be possible to neutralize carburetted hydrogen, as found in the mines, on any other plan than by the diluting principle?—I would adopt two plans, the ventilating plan, and the combustion of the carburetted hydrogen by an aggregation of safety lamps from the roof. I would further conjoin these two, with an occasional sprinkling of the floor with chloride of lime in solution, which would promote the health of the miners, and it would tend very materially, conjointly with the others, to perfect the object of ventilation, by decomposing the fire-damp.

3261. Now, you have spoken of this aggregation of lamps; in what respect would you propose that these lamps should differ in size, construction or principle from the lamps known by the name of Sir Humphrey Davy's lamps?—I should conceive they might be entirely the same; they are not then subject to currents. I would surround, say four of them, with an envelope of wire gauze.

3262. Can you form any idea of what number of cubic feet might be consumed in one of these lamps in any given space of time?—I think this solution has been before the public; I have not myself made the calculation of the quantity of cubic feet of gas that may be consumed, but it is considerable. I have never ascertained the quantity precisely, but it is quite remarkable how rapidly the carburetted hydrogen is consumed by the lamp.

3263. Can you give the Committee any definite idea?—No, I cannot.

3264. Is it many gallons per hour?—I should conceive many gallons per hour.

3265. Do you think there is any plan by which the light given from these lamps could be increased?—I think the simpler it can be done, the better; and the best plan I have seen, is that of Mr. Francis Ellis of Bath, who applied the plano-convex lens externally. The concentration of the lamp by that means is much enhanced, and it is very simple, but I would do more. I would conjoin with it Mr. Roberts's plan, by applying also on the opposite side a reflector; and further, I would have a reflector attached at a specific angle, to throw down the light concentrated by the lens; so that there would be three distinct concentrations of light.

3266. It would be merely a tin reflector?—A tin reflector immediately behind, and projecting at a specific angle, to reflect the rays of light, and cast that light down on the object of excavation.

3267. Are you acquainted with the improvement proposed by Messrs. Upton & Roberts?—As far as I have seen an account of it, I have understood that there was simply a reflector behind, and I think I adverted to that; I am not aware that there is any other plan, though there may have been improvements since. I believe there is one of them on the table, and it appears to be different from the account I have originally seen; but Mr. Dillon, of Belfast, proposed a semi-circular shield of talc, for the purpose of preserving the lamp in a heated state, and by which he has even succeeded in burning gas in the lamp; his object being to prevent the cooling of the lamp.

3268. You have said you are not aware of any difference between the common lamp, usually called Sir Humphrey Davy's lamp, and the one suggested by Messrs. Upton & Roberts, save and except the introduction of a reflector; will you have the goodness to examine No. 6, the lamp before you on the table of the Committee. Do you not apprehend that the inclosing of the gouz with an air-top glass chamber, and a restriction of the quantity of air admitted through the apertures below, entirely prevents the possibility of explosion, inasmuch as the flame can never pass?—I certainly would say that that lamp was superior; that is to say, is an improvement on Sir Humphrey Davy's principle.

3269. Can you conceive any admixture of explosive gas which would be fired by the insertion of that lamp?—I am not aware of the structure of the top, but it will frequently be found that the flame extending upwards, ignites

the gauze at top, it frequently occurs; Sir Humphrey Davy was aware of that fact, and consequently applied a double top.

3270. Do not you apprehend that the current of air being always upwards and circumscribed at the top, that the pressure upwards would be always sufficient to prevent the too near approximation of any inflammable matter?—I certainly conceive that their lamp is sufficiently safe, under all the circumstances that can be presented to my mind at present.

3271. You think that the pressure of inflammable gas downwards would never be exerted with sufficient force to occasion ignition within the lamp, when the flame was raised by the presence of carburetted hydrogen to the first top of the gauze?—There being a double top, I should conceive that were there a possibility of its escaping the first fold of gauze, it would be effectually intercepted by the second. It would undergo such a modification in its transit through the first, that I believe it would not.

3272. You are aware that the second tube has nothing whatever to do with the principle, that it is merely precaution in case the flame, which will naturally ascend to the first layer of gas, should oxydize it or destroy it, than that the upper one should remain the protection, and that consequently the principle is not involved in having two covers?—No; I certainly would recommend myself a non-conducting material to over-top the lamp, above the upper or second fold of gauze. Say a portion of talc placed over its top, for I have very frequently seen the wire-gauze top of a lamp red hot.

3273. Now, in what do you consider the gas generated in the mines to differ from the carburetted hydrogen used in our street lamps?—In that of the street lamp of course there is an adventitious mixture; but oligiant gas, which enters into its composition, may be considered as combined of two volumes of carbon and two volumes of hydrogen; while that of the fire-damp, or proto-carburetted hydrogen, is composed of one volume of vapour of carbon, and two volumes of hydrogen condensed into one.

3274. Now, which of those do you consider most explosive?—I should consider decidedly the coal gas the most explosive when mixed with atmospheric air.

3275. Have you ever tried whether a red-hot iron will light the gas provided for public illumination?—I have certainly tried it, but the question is perhaps not sufficiently definite. Do you advert to an orange red heat, or white heat? because you are aware there is cherry red heat, orange red heat, and white heat.

3276. How would you describe that degree of heat at which the gas used in our streets will explode?—White heat.

3277. Anything below?—Not below, I should say, white heat; and it will require, independent of that, a diameter in wire exceeding that used in the wire gauze, that is a specific diameter; I should say, double the diameter of that used in the safety-lamp.

3278. Then when an individual attempts to instruct his neighbours that the lamp is unsafe, because he can light the street gas with a red hot poker, he does nothing at all?—I do not know what he may mean or wish to be believed, but coal gas is an adventitious mixture, not merely gas, but combined with extraneous matters; as far, however, as my experiments go, the carburetted hydrogen or fire-damp, when uncombined, is among the least inflammable of all the gases.

3279. Is it produced in certain mines in other parts of the kingdom?—Yes.

3280. And it may vary in consequence of this combination?—Yes; but generally I think it is constituted as I mentioned. It is a distinct and definite chemical compound, and not a mechanical mixture as supposed by Professor Brande.

3281. Now reverting to Messrs. Upton & Roberts' lamp, do you conceive any merit or advantage from the cap, which is placed over the lamp, circumscribing the admission of the air so as to meet the consumption of the wick?—It brings it into more immediate contact; but it is a question that at present I am not sufficiently prepared on.

3282. But if the quantity admitted is no more than what the lamp requires for combustion, is not that a safeguard against explosion at the top of the lamp?—I cannot see satisfactorily that it is so.

3283. Do you think that the pressure of the carburetted hydrogen would be sufficient to force its way downward into the lamp while combustion was going

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on within the cage?—I should think not. The force upwards would certainly prevent any ingress from above.

3284. Do you think that any blower could operate upon the orifices beneath the flame, so as to cause a much greater or more violent body of flame in the lamp?—A blower would certainly operate in those orifices that surround the lamp below, but certainly not to the extent that a blower would operate in a common exposed safety lamp.

3285. The glass is a full protection against any external pressure in the shape of a blower, is it not?—Yes, I think it is.

3286. And the lamp would still be a safety-lamp on the common principle if accidentally the glasses were removed?—Yes; the great advantage of that glass cylinder is to preserve the cooling influence of the wire gauze as well as the impulsion of the flames.

3287. Do you think that there is any possibility of the gas finding its way between the glass and the cage?—I do not see how it can.

3288. Of course that must be by descent?—Yes.

3289. Is that possible while the lamp is burning?—I think that is effectually guarded against, if I understand the structure of the lamp; but I am not so well acquainted with the principle of the convex appendage to the base of the lamp, nor do I see clearly its object.

3290. You observe that the orifice is reduced at the top of the glass, the glass is not a perfect cylinder at its extremity?—That I think is an improvement.

3291. Without that there might be some danger of the gas inserting itself between the cage and the glass, to supply the combustion?—Yes.

3292. And you think that that tapering off of the cylinder is valuable?—There is a very curious effect produced upon this simple principle, that I will just mention. A portion of wire gauze when placed over a cylinder like this, so as to narrow the orifice, increases the length of the flame; but in the same ratio diminishes its diameter. It will be found that there is more light and an extension upwards of the flame, but a decrease in the diameter. I have made the experiment frequently by glasses narrowed at top, which I got made for the purpose; and I do find by referring to the gas meter that there is merely a more perfect combustion, but with no additional expenditure of gas as far as the gas meter has determined. Now, I conceive that this operates somewhat on that principle, by decreasing or diminishing the diameter of the flame; but it will certainly increase in the same ratio its altitude, and consequently the apex of the flame will act more powerfully on the top of the cylinder; if, therefore, we apply a plate of talc, as I have already stated, this might be an improvement, but the idea has merely this moment occurred to me.

3293. Do you think that that lamp and one of Sir Humphrey Davy's placed in the like admixture, the tendency of their formation would be to operate more decidedly upon the roof of the lamp than in the other?—Yes.

3294. And that therefore greater caution will be required by any one having the charge of the lamps, periodically to examine the state of the roofs?—Certainly.

3295. It would operate in some respects as a blow-pipe also, would it not, from its construction?—It would.

3296. Without experimenting you could not ascertain or pretend to give an opinion how long it would be before the flame so drawn up would oxydize the iron gauze at the top?—No, I could not.

3297. Do you think it would act with great force?—I should think so, for even in Sir Humphrey Davy's lamp we find very frequently that the lower top is red hot throughout, and consequently, *à fortiori*, it would be so in this case.

3298. Can iron be heated to a cherry red heat without losing a portion of its specific gravity?—I should think that it must necessarily undergo disintegration to a greater or less extent; and I may here state that even when Sir Humphrey Davy's lamp is red hot, if it be quiescent, that is to say, if there is no current acting against it, even at that temperature, say an orange red, it will not ignite the gas, and that there is comparatively no danger save from the coal dust coming in contact with that red hot wire gas, and being ignited; the particles of coal are inflamed and ignite the fire-damp or the explosive atmosphere.

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3299. Have you ever tried the effect of throwing pyrites or dust coal on the ignited gauze of the lamp?—I have.

3300. Did that explode?—Yes; when, for instance, I have held the lamp red hot for some time in an explosive atmosphere, by throwing coal-dust against it, it has kindled the particles of the coal, and these have ignited the surrounding explosive atmosphere, but these particles are soon inflamed.

3301. But do you think that was a fair experiment as illustrating any contingency that might occur in a mine?—I certainly think so.

3302. What would you compare it to?—Suppose the workmen are working with a lamp, say red hot, and that there are particles of coal dust floating in the atmosphere of the mine, a current of air passing through the galleries might bring that coal dust against the ignited wire gauze, when there would be some danger of kindling the surrounding explosive atmosphere.

3303. Then a lamp frequently red hot and cooling, must by degrees suffer a sensible diminution of the bulk of the gauze?—No doubt of that.

3304. It cannot resist the oxygenation when operated upon by the flame of fire damp?—No; but when I wanted to protect it merely from rust or oxygenation, when I adverted before to the protection of wire gauze from oxygenation, it had no reference to the action of the inflamed fire-damp. It was simply to protect it from the agencies of air and moisture.

3305. Therefore, the zinc principle would not prevent the decomposition when acted upon continually by flame?—Certainly not. I conceive it to be, when acted on by flame, a mechanical disintegration of the iron tissue; perhaps a portion may also be dissolved by the flame.

3306. Now, can you point out any simple improvement, such as would be likely to be adopted in the construction of the safety lamp, which may have suggested itself to you in the course of the numerous experiments which you appear to have made?—With regard to preventing the decay, do you advert to that of the gauze simply, when acted upon?

3307. The question alludes to any improved construction which might render it a more perfect instrument?—In a great measure, Mr. Roberts has anticipated what I have elsewhere adverted to. I would, however, have not merely a semi-circular shield of talc attached, in the manner of Mr. Dillon of Belfast, but an entire cylinder, but would carry it only to a certain extent of the wire gauze. I would apply a talc top, as I have stated, and I believe that that is, with what I have before stated, all that I can suggest.

3308. But is that less fragile than glass?—In the case of using it as an exploring lamp, that would prevent the impulsion of the flame against the opposite side in traversing the galleries.

3309. But a glass chamber would act as well, would it not?—Certainly.

3310. Is it less fragile than glass?—Yes; and if Mr. Roberts's lamp was suddenly introduced into an explosive atmosphere, it is probable that the increase of temperature acting upon the glass might occasion its fracture. Therefore, the talc would have an advantage in such a case as this, as it would not be fractured at all, for it is so flexible that it could scarcely be fractured; it would yield in a great measure to blows and pressure.

3311. Is talc easily fused?—It is not fused till it is exposed to an enormous temperature as that of the oxyhydrogene blow-pipe.

3312. The best talc that has ever come under your notice with reference to its transparency, how is it as compared with flint glass?—Very little difference. I have specimens of the talc of Siberia that is very little indeed different in point of transparency from glass, and it has a variety of advantages over glass, such as not being acted upon by sudden temperatures, and being exceedingly elastic and flexible, it would yield under pressure and sustain the safety of the lamp.

3313. Are the Committee to understand that a miner could find no sensible diminution of light if his lamp gauze was surrounded with talc in lieu of flint glass?—Very little indeed, if any.

3314. What is the value of talc, and how is it sold as an article of merchandize?—I am sorry to say I cannot answer that question. It is, however, by no means an expensive affair, because it may be separated into numerous thin plates or laminæ, which would reduce its value to fractions.

Veneris, 10° *die Julii*, 1835.

JOSEPH PEASE, ESQUIRE, IN THE CHAIR.

John Murray, Esq., called in; and further Examined.

John Murray, Esq.
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3315. IN your last examination you stated certain reasons why you should prefer a cylinder of talc to a cylinder of glass; is not talc exceedingly brittle, or liable to be injured by heat?—Not at all; you might have seen it employed in contact with a very high temperature, in the Pantheon, in Oxford-street, through which the fire was distinctly visible, it being almost in perfect contact; it would blister the finger, and at the same time remain unimpaired either in transparency or brittleness.

3316. Has the change from high temperatures to low temperatures any effect upon it?—I should consider that its transparency would not be at all altered by the highest temperature to which it could be ordinarily submitted.

3317. Is it liable to crack or fly?—Not at all liable to crack or lose either its elasticity or flexibility.

3318. So that in case Messrs. Upton and Roberts's lamp was brought into use in any manner, you would give a decided preference to talc over glass as a constituent part of it?—I would recommend the talc in preference to the glass, because there are circumstances under which it might be accidentally fractured; but that is merely a private opinion. I had never seen, before the last examination, this lamp; I have since examined it, and feel fully persuaded that it is an important (shall I call it) improvement on Sir Humphrey Davy's principle. I would decidedly prefer it: I conceive it to be safe under those circumstances in which Sir Humphrey Davy's lamp is certainly unsafe: I speak generally.

3319. Your opinion, as a scientific man, and looking also at the question practically, is, that although Upton and Roberts's lamp may be liable to contingencies which might prove very disastrous, yet that those contingencies are greatly reduced when compared with Sir Humphrey Davy's naked wire gauze lamp?—I am not at all aware at the present moment of any contingencies, save and except this simple one, the incidental fracture of the glass.

3320. And of course the gauze must be injured before any explosion can take place?—Precisely so.

3321. Can you give the Committee any idea of the relative quantity of light passing through glass finely ground, and in the state in which it comes from the crucible?—No; I cannot give any comparative estimate; I have not made the experiment myself, and my memory does not record that which has been done by others.

3322. Are you acquainted with the principle of Clarke's blower?—I think I am.

3323. How would you describe it?—The agitation of the air impelled by a rotatory machine. It may be serviceable occasionally in the process of ventilation.

3324. In what part of the mine would you propose to fix such a machine?—I should suppose at the bottom of the downcast shaft; I would simply place it there as an auxiliary.

3325. Are you aware that the forcing pump has been found in efficiency very inferior to the current obtained by rarefaction over a large furnace?—I am not at all aware that it has; that will depend, I presume, on the power of the forcing-pump, which may be very much increased, and will also depend on the diameter of the tube to that of the cylinder, and so forth, connected with the power of compression.

3326. But you are aware that the principle of rarefaction will be increased to that extent also?—The Committee will perceive I conjoin both these. I raise the quiescent interstratum of air on the renewed and pure air that I force down into the mine, when it is gradually discharged by the superior pipe, the upper orifice of which enters the brazier of ignited coke, and therefore I conjoin the two principles.

3327. In

3327. In the evidence that you gave on a former occasion, I think you expressly stated that you had looked to the principle without reference to any impediment which might arise on the ground of expense?—Precisely so.

3328. Now as regards the use of the chloride of lime, can you give the Committee any idea as to quantities required for neutralizing a given quantity of carburetted hydrogen?—I am afraid I cannot, because the chloride of lime is of such varied specific gravities, and the gas itself necessarily does vary; but I would conjoin that as an auxiliary. I should think it would be of great advantage conjoined with the others, as subsidiary to them, while at the same time it would render the air more pure, more salubrious.

3329. Now, on what principle would you proceed to get rid of the choke damp?—That I think is a very easy matter. Taking advantage of its great specific gravity, it would be merely necessary to conduct it by means of an inclined groove or cavity in the floors, then being conducted into a tank or reservoir in a lower level, it might be pumped up by an attachment to the engine.

3330. Are you aware that the mines are rarely injured by any quantity of choke damp, except subsequently to violent interruption from explosion, which might interrupt also the system which you have alluded to?—Referring to what I stated on a former occasion, I conceive the force-pump would be of great value in propelling pure air into the place to fill the vacuum, which is the consequence of the explosion, and to neutralize the after-damp or carbonic acid gas, which is always the consequence or the result of an explosion of fire-damp.

3331. But that must also suppose that the works connected with that forcing-pump are not materially injured by that explosion?—The entrance into the lower orifice, with reference to coal dust or other particles of debris, might, I think, be effectually prevented by means of a valve at the lower orifice opening into the mine. It would be shut the instant the explosion ensued.

3332. But whatever means were taken to conduct the current of air from your force-pump, those means might be destroyed from the course of that destruction which takes place on a violent explosion?—Of course I cannot reason upon possibilities; but the insertion of a pipe into the brick work or the sides of the shaft, would, I think, effectually protect it in case of explosion; but I should hope, if the treble combination I have presumed to suggest was carried into effect, that explosion would be rare, though perhaps possible.

3333. The treble combination to which you allude, is ventilation by rarefaction, forming a current of air by the use of the safety lamp on its most improved plan, and by the occasional use of chloride of lime?—The chloride of lime would neutralize the fire-damp by abstracting the hydrogen, and necessarily destroying it, because the carbon would be precipitated, or yield a carbonate, and the muriate of lime would be formed.

3334. But the use of chloride of lime over a mine of 100 acres will be a very serious expense, inasmuch as it would require constant repetition?—It would require constant repetition; but I think the expense would not be very great, and it would only be occasionally required in particular localities, not over the entire mine.

3335. But you are not able to give the Committee any idea of the extent to which its neutralizing powers will be found efficient?—No; I have made many experiments, but not on any principle of calculation; I found it effective in neutralizing fire-damp, and I conceive that the forcing-pump, carrying pure air (atmospheric air) into the lower stratum of the mine, conjoined with the carrying off the heated air from the roof of the mine by a pipe, the upper orifice of which enters the brazier of ignited charcoal or coke; these, together with the aggregation of safety lamps, consuming the fire-damp in the superior stratum of the air galleries (that will naturally, in virtue of its specific gravity, ascend to the roof of the mine), further combined with the chloride of lime, would, I presume, be effectual in neutralizing the explosive air.

3336. Now, your experiments have been conducted on a small scale?—They have.

3337. Have they given you any idea as to what quantity of chloride of lime would be required to neutralize the inflammable properties of one or two cubic feet of carburetted hydrogen?—Not at all; I have made the experiments simply upon a small scale in reference to a limited quantity; the suggestion is not mine, it is Mr. Fincham's; I merely say that I would conjoin (whoever might suggest the means) the best principles that I know of, and he (Mr. F.) had, I believe, made

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the experiment in the mine itself; I simply wished to verify his conclusion by my own simple experiments on a minor scale, that it would certainly decompose the gas.

3338. Now you have spoken of the contingencies to which Sir Humphrey Davy's lamp is liable, and of the consequent danger which is incurred in its use; if you had had from 1,000 to 1,500 of these lamps constantly in use in an explosive atmosphere for many years, without any accident, would you not be ready to think that the protection was exceedingly valuable?—My own opinion is that the lamp is conditionally safe, generally it is safe, that is my own private opinion; but contingently it is unsafe; and of course accidents in mines are contingencies; they do not happen every day or every hour; I wish to provide against those contingencies.

3339. But you are not aware of any lamp, or any means of ventilation yet tried, that will effectually provide against all the contingencies which have been brought under your own notice?—Of course, if I understand the question aright, it is simply in reference to the explosive effect of the fire damp: independent of what may be called mechanical injury, I am not.

3340. Therefore it still becomes a desideratum in science, either to provide the means of wholly expelling the gas, of neutralizing it, or producing a lamp that is not liable to any of the contingencies you have already mentioned?—Of course I consider ventilation the prime object; and I fear (I speak advisedly), I fear a misplaced confidence in what is unsafe under contingent circumstances (I am now speaking in reference to Sir Humphrey Davy's invention) has relaxed that attention which ought to have been paid to proper ventilation, while I consider the present system of ventilation not efficient.

3341. Has any case come under your own observation, in which you think greater pains may be taken, or expense incurred, if the safety lamp had not been discovered; that is to say, have you been struck with the neglect of ventilation, and an undue dependence upon the lamp, in any mines that you have visited?—I merely make my calculations on the increased number of explosions and accidents incessantly occurring; simply that.

3342. You are aware that by the aid of the lamp, and the ventilation upon principles heretofore unknown, many valuable mines are now wrought (dangerous mines) which could not before be wrought?—I am quite aware of that, and I am also very much afraid that explosions have occurred in venturing too much upon the lamp under such circumstances.

3343. Is it not reasonable that any coal proprietor will continue working with his lamp till he comes to the very verge of danger?—There is little doubt of that, I think. The miners (the workmen) I believe have been often blamed where no blame whatever attaches. Whenever an explosion occurs, the poor workmen (one would think it is sufficient that they fall victims) are blamed, not the lamp. Now explosions do occur where the lamp is in constant use; may we not suppose that at least some of them are owing to accidents proceeding from the lamp itself being unsafe? I think the conclusion is fair and warrantable; for none remain to tell the tale or the history of the explosion, yet these individuals are blamed.

3344. But if a mine has been worked with safety for a great number of years without any explosion, and in the interval during that time certain instances of carelessness or obstinacy have come under the notice of the manager, such a case as you have mentioned is fairly supposed to have arisen from such a cause?—We have no right to speculate on assumptions; but certainly, where we can prove the assertion, we may draw our inference.

3345. Is there anything connected with your examination last time, on which you wish to make any remarks to the Committee?—I am not aware of any. Perhaps it might be interesting for me to state, in reference to choke-damp, that it may be instantly destroyed by quicklime sprinkled on the floor and watered from the rose of a watering pot; and I have found, in repeated experiments, that inferior animals are resuscitated by being immersed in cold water; I have made a great number of experiments on these points.

3346. Now what is the longest period which you have known animation suspended, from the fatal effects of choke-damp, and afterwards restored by the aid of science or medical art?—Very nearly 10 minutes; but Dr. Paris says, only a very few minutes, not exceeding five; however, I mention the result of my own immediate experiment; I speak advisedly, therefore, when I say nearly 10 minutes.

3347. Now

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3347. Now, have you the means of distinguishing between the full inflation of the lungs with carbonic acid gas, and the absence of gas of every description?—I do not conceive that the carbonic acid gas enters the lungs at all, producing simply a spasmodic contraction of the epiglottis, when the action of the lungs is suspended.

Richard Smith, Esq., called in; and further Examined.

R. Smith, Esq.

3348. DO you wish to make any observations to the Committee in illustration of, or as additions to the evidence which you favoured it with on a former occasion?—In addition to the evidence that I gave on a former occasion, I propose to hand in an additional Paper, which I wish to be added to my evidence relating to the firing of mines, and to the gas to which mines are subject.

[*The same was delivered in, and is as follows:*]

HAVING stated my opinion, that carburetted hydrogen gas is not beyond control or the power of man to subdue its destructive influence in gaseous coal mines, I will proceed to state my views on the system of ventilation.

The matter will be better understood by a few calculations, in the first instance.

Suppose a bed of coal of the thickness of 4 ft. 6 in. in course of working. Suppose also an acre to have been wrought of that thickness, it would contain a space of 196,020 cubic feet:

Thus: 2) 4,840 yards make an acre, 1 yd. thick.
2,420

7,260 yards make an acre, 4 ft. 6 in. thick.
27 cubic feet make 1 cubic yard.

50,820
14,520

196,020 cubic feet in 1 acre, 4 ft. 6 in. thick.

In a letter addressed by John Buddle, esq. to Sir Ralph Millbank, bart., dated Wallsend Colliery, 18th October 1815, he states the standard speed of atmospheric air admitted into a working coal mine, to be 3 ft. per second, through an aperture from 30 ft to 40 ft. area.

Take the maximum, 40 feet area.
3 feet per second.

120 feet of air introduced per second.
60 seconds to a minute.

7,200 cubic feet of air per minute.
60 minutes make an hour.

432,000 cubic feet of air per hour.
24 hours in a day.

1,728,000
864,000

196,020) 10,368,000 (52 A. 3 R. 22 P., or nearly 53 acres in 1 day.
98,010

56,700
39,204

17,496
4

19,602) 69,984 (3 roods.
58,806

11,178
40

19,602) 447,120 (22 perches.
39,204

55,080
39,204

15,876

Upon

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Upon this principle, when one acre only is excavated, the air may be changed 53 times in 24 hours. When 10 acres, then five times in 24 hours. When 53 acres, then once in 24 hours. And when 212 acres, then only once in four days, and so on, as the average of the excavation increases.

Sir Humphrey Davy states, that "when inflammable gas is mixed with three or four times its volume of air, it does not explode at all. It detonates feebly when mixed with five or six times its bulk of air, and powerfully when one to seven, or one to eight, is the proportion. With 14 times its volume, it still forms a mixture which is explosive; but if a larger quantity of air be admitted, a taper burns in it only with an enlarged flame." The question therefore is, what ought to be the minimum standard mixture of common atmospheric air and carburetted hydrogen gas, in a working mine, to keep the pit always in a wholesome safe state? I answer, never less than 20 parts of the former to one of the latter, as a minimum standard.

Suppose then 200 acres of space to have been excavated, and still remain so, in a gaseous coal mine of an average depth or thickness of 4 ft. 6 in. throughout, and which mine generates gas at the rate of 20 per cent. of its own open space in 24 hours; it will be equal to 40 acres of inflammable gas in that period. To dilute 40 acres of inflammable gas, and reduce it to the proposed standard, by an admixture of common atmospheric air, will require 20 times 40 acres, or 800 acres of atmospheric air, introduced in 24 hours, which could not be accomplished under a speed of 15 times that laid down in Mr. Buddle's letter.

Example:

196,020 cubic feet in one acre.
800

Cubic feet of air introduced in 24 hours, at a speed of 3 ft. per second - - - } 10,368/000) 156,816/000 } Cubic feet of air in 800 acres: 15 days current to supply 800 acres of air.

10,368

53,136
51,840

1,296

If, therefore, a mine already excavated to the extent of 200 acres, yielding 20 per cent. of its own space of gas in 24 hours, is to be diluted and reduced to the proposed standard, it is quite clear that the atmospheric air must be introduced into such mine at a speed of 45 feet a second, or 15 times Mr. Buddle's limitation, provided it be confined to the same aperture, and which aperture is more than equal to a circular shaft 7 ft. diameter in the clear, and nearly equal to one-half of a 12 ft. brattice shaft. It is already in evidence before the Committee, that the maximum speed, of from 3 ft. to 4 ft., at which air is allowed to travel in coal mines per second, has been so fixed to accommodate itself to the safety lamp, it being understood that the safety lamp is liable to explode when meeting a current of air exceeding that standard. If, therefore, the current be confined to the standard speed, it is evident that a mine producing gas at the proportion of one-fifth of its own space in 24 hours, cannot be safely wrought to the extent I have mentioned, if the air is to be coursed through all the passages of the mine. The working space of such pit must be limited to one-fifteenth part of 200 acres, or about 13 acres of excavation, whilst the produce of gas maintains that ratio; but either diminish the supply of gas by natural exhaustion, or increase the speed of the atmospheric current, and the excavation may be extended in the same proportion. The following Table gives the limit in acres to which each pit should be restricted, according to its daily produce of gas; and supposing all the gas to be absorbed by atmospheric current, and that current never to exceed the proposed standards of admixture and speed.

Scale.

Supposing the speed of the current to be restrained to 3 ft. per second, 10,368,000 cubic feet of atmospheric air introduced every 24 hours.

Produce of Gas.	Atmospheric Air.	Extent of Excavations in each Pit. A.	R.	P.
20 per cent.	10,368,000 cubic feet per day	13	0	35
19		13	3	27
18		14	2	30 ½
17		15	2	9
16		16	2	4
15		17	2	21
14		18	3	22 ½
13		20	1	14
12		22	0	6
11		24	0	6
10		26	1	31
9		29	1	21
8		33	0	9

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Produce of Gas.	Atmospheric Air.	Extent of Excavations in each Pit. A.	R.	P.
7 per cent.	10,368,000 cubic feet per day	37	3	5
6 —	—	44	0	12
5 —	—	52	3	23
4 —	—	66	0	19
3 —	—	88	0	26
2 —	—	132	0	39
1 —	—	264	1	38
½ —	—	528	3	36
¼ —	—	1,057	3	32

The above table shows very clearly to what extent excavations in gaseous mines may be made (in proportion to the productive power of the gas in such mines) consistently with the following standards, which are here established; viz.:

1st. The standard of mixture of atmospheric air and carburetted hydrogen gas; *i. e.* 20 of the former to one of the latter.

2d. The standard of speed of the current of air, viz. 3 ft. per second, which produces through an aperture of 40 ft. area, 10,368,000 cubic feet of air in 24 hours. And,

3d. The standard of acres, as a limit of excavation, to be governed by the preceding table, according to the produce of gas in each mine, and the mode of ventilation.

It is very striking, on a view of the last table, how few acres can safely be wrought at one pit by the universal coursing of the air, when the gas is at high pressure. For instance, if the gas is at 20 per cent., the average of excavation ought not to extend beyond 13 A. 0 R. 35 P., whilst at one per cent. it may be extended to 264 A. 1 R. 38 P.; and if as low as one quarter per cent., then to 1,057 A. 3 R. 32 P. But these calculations show how necessary it is that a most careful and attentive watch should be kept over the ventilation, by skilful men of tried sober habits.

Cold air in descending the downcast shaft expands greatly by the caloric imparted by the horses and men, and by the natural warmth of the earth, so that a greater volume ascends the upcast shaft than descends the downcast; to which also must be added a further increase, in proportion to the quantity of gas generated: the speed therefore of the current through the mines will much exceed 3 ft. a second, where the aperture does not exceed 40 square feet.

The produce of gas is presumed to arise throughout the mine generally, including blowers supposed to exist in various places, thereby making an average of the whole, although it is known that blowers are much heavier in some places than others; but on the principle of an average, the air will become charged with one-half of the volume of gas, by the time it has travelled through half of its assigned course, and it will have to collect the remainder after it has passed the workmen, and is on its return to the upcast shaft. The atmospheric air never ought to have absorbed more than 30 or 40 per cent. of its standard quantum of gas, till it has finally passed the workmen who are using naked candles, particularly where they are exposed to goaf ventilation, and where the infalls can possibly bring down fresh supplies of gas from superjacent coal. Hence the necessity for a skilful steady man, whose duty it should be to test the gas periodically at assigned stations, equidistant from each other, throughout the pit.

In the absence of a better mode of testing the state of the air, I would propose the following:

Let the testor have a laboratory or room in some safe and convenient part of the pit, in which he shall have a vessel constantly supplied with pure gas. He shall then be furnished with a number of bottles of a given size, each marked with its own number in numerical order, to correspond with the numbers of the stations from whence the air is to be collected. He may, or not, have pockets in his dress, fitted to each bottle. On starting to collect the air at each station, each bottle should be filled with water, and on his arrival at each place, the testor should hold the bottle in the current, and allow the water to escape, which being filled with air should be well corked. The same mode should be practised at each station. On the testor's return to the laboratory, he should transfer the air from the bottles into vessels suited to the experiment, and add to each a measure of pure gas, the size of which should be fixed to correspond with the known or usual state of the air at each station. This measure, when added, ought not to explode, although the previous mixture of atmospheric air and gas may already be as high as the standard usually assigned to the station from whence the air had been taken; but if it did explode, it would at once prove an improper increase of gas in the volume or current at the time of passing such station. If such increase were uniform at all the stations, it would show that some relaxation in the current had taken place, either for want of attention at the furnace, or some other cause, which the testor would closely investigate; perhaps from great summer heat above ground, which often checks ventilation. But if he found a manifold increase of gas between any of the proving stations, he would infer that some recent event had taken place, either by the giving way of some of the stoppings, by irregularity in opening and closing the doors, or by an infall of the roof. If necessary, he would withdraw the men till he had satisfactorily ascertained the cause, and whether real danger did exist or was likely to arise from it. Every experiment or analysis may be recorded in a log-book kept for that purpose.

After having extended the excavations in each pit as far as the principles laid down in the foregoing tables will justify, I would suggest, that in bringing the work home (by getting

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out the pillars), a substantial air passage should be left around the entire workings, and have a direct communication with the upcast shaft; it should be well supported and protected by a belt of coal or pillars of sufficient strength left for that purpose. The object of such passage would be to carry off all the gas arising from the surrounding coal left in the quick, and prevent its combination with the internal production. The homeward-bound works should commence in the crop, and as near the upcast shaft as circumstances would admit. When the goaf was known to cover a certain extent of ground, or to be heavy in the production of gas, an inner belt of pillars should again be left, which by proper stoppings should cut off all connection with the future works, and compel the goaf gas to find its way to the upcast shaft along the outer air course. Every succeeding goaf should be cut off from time to time in a similar way by belts of pillars, which pillars may be reduced in the first instance; and thus the great body of coal may be effectually wrought with safety to the men, provided ordinary care is exercised. I am aware that some coal will be left unwrought, that may never be got; but when it is understood that it is to save the lives of men, no human being of proper feeling will hesitate for a moment to make the sacrifice.

It may also be stated, that the quantity of gas generated by the old goaf will be unsafe in passing through the furnaces. When the testor reports this to be the case, abandon furnace ventilation entirely, and adopt the fan or blow-george, to be worked by steam power, on the principle of John Martin, esq., and on which principle ventilation might be adjusted to any given standard or regulation consistent with the safety of the Davy-lamp, as it now stands improved by Messrs. Upton & Roberts.

In offering these condensed observations to your Honourable Committee, on the mode of ventilation, I hope I shall not be accused of finding fault with the plans already in use, but be considered as actuated purely by a desire to assist my brother engineers in preventing as much as possible the loss of life, by that devouring element carburetted hydrogen gas, which has ruined and destroyed the happiness and comfort of so many suffering families, amongst that useful class of men, British miners, whose daily bread is obtained by hard-wrought earnings, amid the thousand dangers by which they are constantly surrounded.

Mr. *John Roberts*, called in; and Examined.

Mr. *John Roberts*.

3349. YOU are at present resident in London?—In London.

3350. And are engaged as a manfacturer of lamps of various kinds?—Yes; and I have also been employed for many years past in endeavouring to improve the miner's lamp, and to bring it to a state of perfection.

3351. Are you a native of this part of the country?—No; I was reared in St. Helen's, in Lancashire.

3352. Have you been acquainted with mining operations for a considerable length of time?—For more than 25 years; I went when I was very young, and have been more than 25 years in the mines.

3353. In which mines were you first employed?—Colonel Frazer's, in Ravenhead Colliery, St. Helen's, which I believe now goes by the name of Grove's Colliery.

3354. How many years were you in that colliery?—Several; I was what they call a drawer, never as a workman there, for I left that part of the country before I was 16 years of age.

3355. What was the next scene of your occupation?—The same pursuit under the Earl of Balcarras, nigh Wigan.

3356. Have you since been in any other mines?—From thence I travelled into Staffordshire and Worcestershire, and worked in the thick coal, as it is called.

3357. Have you ever been in mines near Whitehaven, in Cumberland?—On first leaving that part of the country I went into Lancashire, and from thence to Newbottle; I was but a short time there, finding it very dangerous, in consequence of inflammable air; and being acquainted with a young man in that neighbourhood, who had worked in Cumberland, he was very fearful of inflammable air, and pressed me to accompany him to Cumberland, which I did.

3358. And you visited Cumberland?—I visited Cumberland.

3359. Were you engaged in those mines?—Yes.

3360. For any length of time?—Between six and seven years. I worked about 18 months under Squire Curwen, of Workington, in the Isabella pit; but work being very scanty there, I went to work under the Earl of Lonsdale, in Whitehaven.

3361. Then after leaving Cumberland, what part of the country did you visit?—I went to London. The cause of my leaving Cumberland was from a discovery called the "safety-hood," which Mr. Curwen wished me to take to London. He paid my expenses, and desired me to go to the Society of Arts with it. I afterwards returned to Adlington, and worked in the Early mine, belonging to Mr. Kensey.

3362. Then

3362. Then from thence which way did you shape your course?—To London.

3363. Have you been in London ever since?—No.

3364. Have you continued from time to time to visit the mines since you came to London?—I have since visited the mines in Staffordshire, but have not worked in any.

3365. Now, are you able to state, from your own knowledge, whether the mines in the neighbourhood of St. Helen's are what is called fiery, or dangerous mines?—There are some of them that are troubled with the fire-damp, and others with what is called the black-damp.

3366. By the black-damp is meant the choke-damp?—No, carbonic acid gas.

3367. Did any accident take place in those mines during the period that you were engaged in them?—Yes.

3368. About what year was that?—One happened about 1802, by what is called black-damp, and I was the only person, but the one that met with the accident, in the mine at the time. When the black-damp approaches near the lamp, sometimes the drawers have to fill their baskets in the dark, as no light can then be kept in. In this case I was coming down to what is called the "stage." Finding the waggoner lying against the basket, I fancied that he was shamming sleep; but going round him, and feeling him, without being able to make him move, I plucked the basket away and then I brought him to the level, when I found he had been struck with the black-damp. Being in the lower part of the mine when I plucked the basket, as it were, from his head, by which it was supported, I was greatly alarmed that he did not speak. I then placed him in the waggon, and ran him to the air-pit or shaft.

3369. To the bottom?—To the bottom. Placing him into the basket, I called to the men above to wind him up to the bank, which they did, but more than one hour elapsed before he came to himself.

3370. Did any medical man see the sufferer?—No, it was too great a distance; the usual mode that they adopt was then resorted to, which is, cutting a hole out of the earth at the surface, and placing him with his face downwards to revive him.

3371. Was the man restored to life?—Yes.

3372. Had he appeared to be dead for the space of one hour?—Yes, for the space of one hour.

3373. You are aware these means you have described are not those recommended by medical men?—Yes.

3374. But it was at that time the practice?—It was.

3375. Have you seen frequent accidents of that kind from choke-damp?—I have not seen them very often, but I have heard tell of them frequently. Another part where I worked, in a very thin seam of coal, produced both inflammable air and what is called black-damp.

3376. The black-damp always comes on after an explosion, does it not?—Gas of a similar nature does, but it is not called black-damp; the term that the miners give the air which comes after explosion is "burnt sulphur;" it goes by the name of sulphur, as the fire-damp does with some people. Black-damp is free from taste or smell, and generally more pernicious than the burnt air. The properties of black-damp vary very much indeed; in some mines the men may work for a year in them, though at the same time they can scarcely keep a light; frequently they cannot keep a light at all in them; sometimes it is so abundant, that in the course of one hour thousands of yards of space are filled with this gas. In parts of a mine strongly ventilated, I have seen black-damp close by the air course, where it has been travelling so rapidly that the workmen could scarce keep a candle in. A workman accidentally placing his head not more than a yard from the free current, would be very likely to fall a victim to it, if not immediately removed.

3377. Have you visited those mines recently?—Not of late.

3378. Are you aware whether the system of ventilation which was in use at the time you were there, still remains, or has been at all changed?—Some parts remain, others do not. I have reason to believe the best modes of ventilation continue in use, and that in the large collieries it is carried to the highest pitch that it possibly can.

3379. Ventilation is?—Yes.

3380. Now, are the several collieries that you refer to ventilated upon the same principle?—There are some collieries now which adhere to the original plan, that is, by lowering down a grate, without having a proper furnace. The grate I consider of very little use; the stoppings are of great importance to the proper ventilation

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lation of a mine; there may be some thousands of them, as they are made perpetually with the work; each stopping ought to be thoroughly filled with stone, or brick and mortar. In some collieries where I have been, they take that precaution with brick and mortar; in others they do not, and there they are not so well ventilated: in these the small coal and rubbish are thrown as near the roof as they can, to make a stopping; but they are liable to fall down from the ceiling, and allow the air to pass over, instead of going into the proper course to ventilate the works. When the men are working where this mode of ventilation is practised, if the weather becomes heavy they are frequently driven out of the mine. I consider that a bad mode or system of ventilation, where the air-stoppings are not sure of being kept perfect. The stoppings should be as tight, or as near so as possible, in order to allow the air to circulate round the works where the men are.

3381. You have just drawn a distinction between perfect stoppings with stone or brick and mortar, and those formed by a barrier of roofs?—Yes.

3382. Are you alluding to the practice that prevailed in the mines of Lancashire, or the mines of Durham, Cumberland and Staffordshire, which you state you have since visited?—This mode is carried on in Lancashire, where the works are not very extensive. It sometimes becomes a great annoyance in the autumn, which prevents the workmen following their daily occupation, and is in this respect a very great evil to the master, in interrupting the working of the coal.

3383. In addition to the interruptions which ensue to the working of the mine, has such neglect, in your experience, led to fatal explosions?—Yes; I have no doubt but that it has been the cause of various explosions, particularly where it is the habit of working what is called the boards or drifts. In that part of the country they do not use brattices or partitions to carry the atmospheric air close to the face of the workings; they have other modes of ventilation, but I do not think them effective.

3384. Then the accumulation of foul air in the boards, in addition to what exudes in a certain state of the atmosphere from the imperfect stopping, has been the cause of that dangerous accumulation of gas?—That has been the cause; but of late years they have improved the ventilation by furnaces in the bottom.

3385. You are still alluding to Lancashire?—Yes.

3386. This was about what year?—This was about 20 years ago.

3387. About the year 1815?—Yes.

3388. Now when you visited Wallbottle, did you consider that mine in a dangerous state?—It was highly dangerous in some parts of the seam.

3389. Had the safety-lamp been introduced when you were at Wallbottle?—Yes.

3390. And how long were you in Wallbottle mine?—Not quite 12 months.

3391. Did any explosions take place while you were there?—There was one man severely burnt.

3392. Was he a hewer in the boards?—He was what is called a wasteman, staying the props and laying the railway.

3393. Was it previously to the other workmen having descended to work?—No, they were descending at the time; there were upwards of 500 men and boys generally at work in that shaft.

3394. Do you mean to say the explosion took place in the shaft?—No, it was during the time the miners were descending the shaft in the morning.

3395. Did that fire extend beyond the drift-way in which they were at work?—Yes; and so great was the alarm, the waste not being very far apart from this, that the work was laid idle that day; and if it had proceeded 15 or 20 yards further, it would have been fatal to nearly 500 lives that morning.

3396. Was the man killed?—I do not know whether he died or not, but he was severely burnt at the time.

3397. Is it not the invariable practice in the district which you are speaking of, when any man loses his life in the colliery, to abandon work for the whole of that day?—Yes; but as his life was not extinct then, they abandoned work just the same as they would had he been burnt to death. Others have been much burnt in the same colliery, of which I have been an eye-witness, but the work was not abandoned, except in the single boards where those men were working.

3398. Now, were there any men killed by explosions in Wallbottle colliery during the time you were there?—None.

3399. Did any men lose their lives from explosions in either Mr. Curwen's or the Earl of Lonsdale's collieries, during the time you were in Cumberland?—Yes.

3400. Was

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3400. Was the safety-lamp in use at that time?—Yes, all had safety-lamps.

3401. This was about 1816 or 1817?—I quitted the Earl of Lonsdale's colliery in 1824.

3402. Now, were you present at the time when any of these explosions took place in the Cumberland mines?—Yes, one in the William pit; I was working in the same employ, but not in the part where that explosion took place. I helped to fetch the bodies of the people out, and also those of the horses. To the best of my recollection, there were 33 bodies of human beings and 17 horses. Not one was remaining alive out of those in the pit when the explosion took place.

3403. Were any women lost upon that occasion?—Yes.

3404. Do you recollect the number?—No, I do not.

3405. Was it considerable?—Yes.

3406. Do you remember the total number of lives lost upon that occasion?—To the best of my recollection, 33; all had safety-lamps.

3407. Did you work with the safety-lamp yourself?—Yes.

3408. Now, will you state to the Committee what you apprehend to have been the immediate cause of those explosions, seeing the men had the protection of the safety-lamp?—It was attributed to carelessness in the use of the Davy-lamp, or rather to some one taking off the top; but as every means had been taken to secure the top of the lamp, I consider that it most probably arose from the insecurity of the lamp itself, as I have every reason to believe that the men, knowing the dreadful consequences of an explosion in so extensive a waste, were careful in what they did with the lamps.

3409. That would have been a natural inference; but are you not aware that some men will go to their work in a state of intoxication, and that others are very wilful?—I have never seen a man go in a state of intoxication to his work.

3410. Have you never seen any instances of what are called fool-hardy men?—Some persons may call them fool-hardy men who will volunteer themselves to risk their lives to save another's.

3411. But would you not call it fool-hardy in a miner to continue an indefinite length of time with his safety-lamp full of fire, knowing and seeing that such was the case?—No, I do not consider it fool-hardy when it has been prompted to him that the lamp is safe. At that time all the men I knew considered it so; but I do not recollect seeing them continue at their work with it in that state. They are not all wise men; one workman might not be so careful as another workman; but then he is told the safety-lamp is safe, and he depends his life on it.

3412. And your conviction is, that if a lamp under these circumstances was so injured as to destroy the principle on which it is supposed to act, that it is to be attributed to ignorance of the consequences, rather than to a disposition to brave the consequences?—Yes; all miners when they see the lamp filled with the flame, approach it as quickly as they can; but sometimes from the situation it is placed in, they cannot readily get to the lamp, for it might be hung upon a prop or on the side of the pillar, and there might be coal in the way, so that they could not get to it in time before the lamp would get to that heat that the gas might be ignited from it.

3413. Do you mean to state then, as your experience, that a miner will without delay remove his lamp, or extinguish it, the moment he sees it full of fire?—He makes all the haste he can to his lamp, and uses all means that he possibly can to take his lamp down from that part.

3414. Now, has your own lamp ever fired?—Yes.

3415. Did you continue at work five or ten minutes with it in that state?—No, not a second, if I could help it; the moment when it fired, if I was working the waste, I acted with caution, and the moment I saw it flash and the flame got elongated in the barrel, I took it down, and placed it on the floor, and literally had not any light to work by.

3416. Now do you, from your experience of mines, think it an impossible circumstance, that a man will continue working for 10 minutes or a quarter of an hour with the gauze red hot?—If they do they are not aware of the consequences that might ensue; but where there are thousands of men, they are not all possessed of judgment to know what state of danger they are in, and therefore some may stay longer than they ought.

3417. Now, is it the want of fear or knowledge?—It is both; for some are fearful, and some have not got the proper knowledge to direct them.

3418. Now, were any pains taken in the collieries in Cumberland to explain to the

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the workmen what the point of risk was in the use of the lamp?—Never, that I heard; no explanation of that kind took place during the time I was working in that mine, under the Earl of Lonsdale.

3419. Then the waste-men and over-men were trusted to for removing the lamps in all cases of danger?—In all cases of danger the men have to remove the lamp; hundreds of times during the day each man might have to depend on himself for safety.

3420. Now, have you ever known an instance in which the gas has exploded from the lamp, whilst it was in a state of rest?—No, not if both the lamp and gas were at rest; but neither the gas nor the lamp can in a coal mine be often at rest; in some places large quantities of inflammable air come very suddenly on the men; at Saltonlow Bottom, in Cumberland, an immense quantity of inflammable air came from one working, I should say as at the rate of 100 yards an hour; this has been where the brattice has been knocked down.

3421. Do you mean it was generating throughout the mine at that rate?—Yes; I will give you an instance of its extent: the shaft being about 18 feet in diameter, such an abundance of this inflammable air was rushing out from the coal, that it was carried off and brought up to the surface by a large iron pipe, and would sometimes take fire from a very high chimney; on a calm day the flames would be often as much as 24 feet in height, and as much as three yards and a half thick.

3422. Then the gas was conducted by foul air drifts into the shaft?—No; the ventilation was carried on there as great as possibly could be; the ventilation was so great that it was very difficult to open the doors; the pressure of air was so great that you could hear it whistling through the crevices as you would hear it in a country cottage in the winter time on a stormy night.

3423. Then do you mean there was but one air course through the mine?—There was only one air course in that mine to take a circulation.

3424. Are you not aware of a system called drawing the air, by which one portion of the air carried to the dangerous parts of a mine becomes charged with foul air, and is carried into the mine on a higher level, through what is called the foul-air drift?—Yes, that is the waste.

3425. Was there a foul-air drift in addition to the free air course, in the mine of which you have been speaking?—Not in this mine.

3426. Then the whole of the air rushing from the mine was in an inflammable state?—It was in an inflammable state; but there was such a quantity of fresh air that it prevented its gathering in large quantities further than what would collect in each person's working.

3427. Now, while you were in the Cumberland mines, did any of the lamps explode?—In the mine that I mentioned, John and Thomas Jackson (father and son) both lost their lives in Saltonlow Bottom, where I worked.

3428. Will you tell the Committee what were the circumstances of that explosion?—The first thing in the morning, when there is a super quantity of gas in the single workings, the habit that they have of removing this is taking their coats, and what is called brushing or sweeping the place; they take their coats and agitate them, and cause a circulation of fresh air and intermix it with the inflammable air, and by that means work it out for a few yards; every precaution was taken by the father and the son; they went into the workings in the dark, placed their two lamps in the air course, and when they agitated this inflammable air it mixed with the atmosphere and fired the lamps, and the lamps exploded, and the fire traced up where the father and the son were; they were both burnt to death.

3429. Now, are you able to state how far the lamps were at that moment from the face of their work, when they were agitating the air to get that ventilation which you have just described?—It might be from 10 to 20 yards distance from them.

3430. Do you speak with certainty as to the distance?—I cannot tell to a few yards, but the distance between each cut through from one working to the other, is about 20 yards, and then they threil an opening, and when they cut through one they close the other up so as to carry the atmosphere close to the board.

3431. Now, can you tell the Committee, from your own knowledge, whether the lamp was placed in the threil or in the board at which they were at work, driving onwards?—It was placed in the return air course.

3432. In a direct line from the face of the jud, or otherwise?—They had placed the lamp in the gateway.

3433. The explosion then extended no further than the board at which they were at work?—No further.

3434. This

3434. This is what is called in the north a fire, is it not?—Yes, the single work fire; but the concussion of the air was so great that a young man was killed; he was sitting by the stage waiting, when the horses were coming in the steir; I think they call it so in Cumberland; the violent shock from this explosion forced the young man against the pillar and fractured his head, and thus caused his death.

3435. That was the result of the concussion?—Yes.

3436. What distance do you apprehend he was from the point of explosion?—I should think 140 yards.

3437. Are you acquainted with any similar incident to that you have just mentioned?—No, not in those mines; but there have been many fatal explosions in them since that, as well as before.

3438. Were there any other explosions during the time you were working in those mines?—Yes, after that, in William pit.

3439. In the accident which you have just described, had you the opportunity of examining the lamps subsequent to the accident?—The lamps were carefully examined, and all the lamp tops were found to be screwed on, so that it appeared that every precaution had been taken.

3440. Was the gauze perfect throughout?—The gauze was perfect throughout.

3441. Was it to the gauge prescribed by Sir Humphrey Davy?—I believe it was.

3442. Now, can you describe the cause of any other accidents which occurred in the Cumberland mines at the time you alluded to?—Nothing was traced further.

3443. The fact is, that knowing that under the circumstances named the lamp had exploded, you became fearful that there were other circumstances as well as this in which it might explode?—Yes.

3444. Were you aware at that time that Sir Humphrey Davy had warned those who were immediately round him when the lamp was introduced, that such a current as would be produced by the agitation of a man's coat, or in any other way, would explode the lamp?—That was not told to the miners, at least I never heard of it.

3445. You were not aware of it at that time?—Not at all at that time; if that had been the case, the men would not have worked in these parts, which was a great advantage to the mine-owners, for formerly when they worked with candles, sufficient coal was left as pillars to keep the roof, so as the air should traverse, and no quantity of gas should be communicated from the rock falling in the waste; but after the lamp was introduced its safety was prompted to the workmen, which induced them to take out these pillars from the waste or the broken work, and it was too often the case that such quantities of inflammable matter, more than a thousand yards, would be collected in one night. It sometimes happened that when the men had been working in various directions, taking out some of the pillars, the inflammable air at this time would escape as it were from the roof and flooring, by the immense pressure of the surface, which pressure on the pillars would often create a breakage through them and let a quantity of inflammable air escape, so much that in the morning when they came they would find the place full of this inflammable air, when over-night there was nothing seen of it.

3446. But recurring to the accident, you do not mean to state it as your opinion that the accident would have occurred if the men had not agitated the air in the way you have instanced?—I cannot say positively if the lamp had remained in this inflammable air quiet, that it might have exploded so suddenly.

3447. That is to say, you think it possible the lamp would have exploded if the men had quietly commenced work without endeavouring to improve the ventilation?—Yes.

3448. Now, will you give the Committee your reason for supposing that the lamp would have exploded the atmosphere in a state whilst it (the lamp) was quite entirely at rest?—I have seen such quantities of inflammable matter myself in various parts, that a current of air has been traversing so rapidly, that it would nearly blow the lamp out.

3449. Well, but was not the lamp at this time in exactly such a situation previously to the men beginning to agitate the air still more?—No, I do not suppose it would in some cases.

3450. No, but in this case?—Perhaps it might; but when there are falls of

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earth the air will be more agitated than the workmen could agitate it by passing the lamp through it.

3451. But the lamp did not explode until the workmen agitated the air to ventilate their board?—It did not explode till then, for it was placed where there was no inflammable air till it was agitated.

3452. Then your opinion is, that the air current may be rendered by the mixture of gas so highly explosive that it will force the flame through the gauze when the lamp is at rest?—Yes it will, when the lamp is quite at rest.

3453. Have you ever known such an instance?—I never risked such a chance as to try to that pitch in the mines myself.

3454. If you have never known it in the regular air course, it would not be so likely to happen on the face of the waste?—No.

3455. But are you not aware that it is peculiarly necessary to force a great current of air along the face of the goaf or waste?—Yes.

3456. How do you account for the air, then, being what you call slack on the face of the waste?—That is, not traversing so quick.

3457. Do you mean to say that the drift is of a larger area on the face of the waste than in other parts of the mine?—It is much more extensive in the waste than what it is in the air passage.

3458. Do you mean to say that the air coursing is interrupted on the face of the waste, which impedes the current?—It is not interrupted, but it has so wide a space to circulate through, and is so slow in its motion, and such a quantity of inflammable matter mixes with it between there and the upper part of the ceiling, or next to the roof, that it will fill the lamp full of flame; but in the air course, which is generally four feet and a half or five feet wide, the air is traversing very rapidly, and I have seen it when the air course has been so full of this inflammable air, that it would blow so rapid that one could scarce keep the light in, and a foot out of this current of air the lamp would explode.

3459. Then it becomes the duty of the wasteman to approach these currents with as little delay as possible?—Yes.

3460. This may be done by passing a short brattice in the current?—Yes; but I do not think it is requisite myself, as no one is working in that neighbourhood; it is on purpose for the air to traverse. No one is working within a mile or two of this place, and therefore the brattice is not requisite.

3461. Are you not aware lamps are lit for passing along the railway at certain distances from these places?—Yes.

3462. And that if the gas came out in sufficient quantities, and was carried up to these lights, provided they were naked lights, that it would explode the whole mine?—Yes, it might so happen; I am speaking now not in the railway, but in the return place, where there is no traversing, only by the wasteman.

3463. Well, but are you not aware that it is necessary to keep that air course as free as possible?—Yes.

3464. And that it is part of his duty to carry off the gas without delay, whether it comes from a fall or from the regular working of the mine?—Yes, every precaution should be taken to do so. In the course of my experience falls have taken place which have interrupted the ventilation, by knocking down the fly and other doors. When the air is traversing through the air course there is no one travelling but the wasteman who superintends the gates; there is at times such a quantity of inflammable matter, extending some hundreds of yards, that the air is traversing very slowly, and the upper part of the ceiling is filled with inflammable air, and at the lower part there is an under current of air also traversing.

3465. Then of course in such cases the current of air is not sufficient to fill the area of the air course, as you must be aware that it acts with mechanical force as well as upon chemical principles?—Yes.

3466. Then would you call such a mine well ventilated?—Yes; if ventilation is carried to the highest point it is capable of, which it might be without preventing the mine being at times in this state.

3467. Do you think any mine can be well ventilated in which the body of air in the air course is not sufficient to sweep that air course?—No; but when the air goes round a number of pillars where the men are working, it cannot fill the space and pass with that rapidity that it does in the regular air course.

3468. But supposing that I lay down as my standard that I will pass my air at the rate of 4,000 feet per minute, can I not, by bringing my air at the rate of 8,000 feet

8,000 feet a minute, obtain 4,000 in each divided course?—Yes, if they are divided.

3469. Now, do you not think that in this way the mine may be still well ventilated, provided I can secure a sufficient velocity in each of the divided air courses?—Yes, parts of it might, and others might not.

3470. But do you call a mine well ventilated when the air is not sufficient to sweep it away?—It may be called well ventilated, and yet not be possible to sweep all the inflammable air away. There is great danger in taking out these pillars; the inflammable air is driven from the roof when it falls in, which frequently happens in this operation. The inflammable air will then require more than twenty times its own volume of atmospheric air to render it harmless to the workmen.

3471. What you mean to say is, that it is impossible to ventilate the waste?—Yes.

3472. You admit that the great and grand desideratum in these inflammable mines is to carry off the accumulation of gas from the waste?—Yes.

3473. Every part of the mine may be satisfactorily and well ventilated?—Every other part I conceive may.

3474. Now, has any plan occurred to you by which you can get an outlet for the gas at the extreme end of the waste?—No; for there are such quantities of this inflammable air, which I have seen arise in such a short time, that one would suppose that it would take the whole air course to sweep it away.

3475. You are aware that the air courses may be multiplied?—Yes; and every precaution is, I believe, taken to carry pipes up the brattice, to force the air in these crevices; but that is not sufficient.

3476. You are aware that the great difficulty is, to preserve the air course through a falling mine?—Yes.

3477. They might have an upcast shaft to carry off the noxious gas, provided they could maintain their course when the mine was falling all round: this alludes to pillar workings?—Yes; but this is not practicable, as to expense: the working the pillars is not confined to one part of the mine.

3478. But when you absolutely work the second time over, when you work your pillars, how would you separate your ventilation in the waste when you are clearing the mine?—By conducting the air into the entrance of the broken work, and forcing it round the pillars by means of fly doors. Air will take the nearest way, it will not go out of it; it is like water; and I have seen the inflammable air back the fresh air, although an immense quantity of fresh air floating round the face of the waste, at the distance of six or nine or 12 feet.

3479. Now, are you not aware, as a practical man, that whatever be the area of the workings, it is in the power of the viewer to fill that area with atmospheric air?—I believe it is not in his power to do it in this case.

3480. Can you suggest any means by which the air coursing may be kept up through the body of the goaf, so as to keep it clear of gas?—I am not aware of any means by which that can be done.

3481. Are the workmen or wastemen in the mines in the habit of carrying their lamps through air courses, with one side close upon their bosoms?—Yes; that is when they are travelling: when the air is traversing very rapidly, they are obliged to put the lamp under their coat to keep it from blowing out; for so great is the air passing through, that they can scarce open the doors in some parts.

3482. How are you aware of the velocity of the current, or how will you describe the velocity of the current in that mine?—There are various ways to ascertain it.

3483. Was it a well ventilated mine?—A well ventilated mine; so well ventilated, that an immense furnace was erected at the bottom of the mine, where there is four or five ton of coal consumed each day, and some hundreds of thousands of yards of atmospheric air circulated through it.

3484. Were there no other men at that time in any other part of the mine?—None in the mine where the explosion happened; the three killed were found in the gateway, returning to the shaft.

3485. And were the lamps injured?—The lamps were not injured.

3486. Were they found to be perfect on examination?—They were.

3487. Now, in the Staffordshire mines, have you ever seen the men working there with lamps?—The lamps were not introduced at the time I worked in Staffordshire.

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3488. Have you been in the Staffordshire mines since the lamps were introduced?—Yes.

3489. Do the men use them regularly, or only occasionally?—Only occasionally, to try the upper parts of the chamber, the cuttings. They have to cut the seam to ascertain if there be any of this inflammable air, for the lamp does not afford them light to work with; they are nearly in darkness at the upper part (the ceiling), and the great work is there, cutting over the shoulder along the wall; underneath the lamp they are in entire darkness.

3490. And therefore the men object to use these lamps?—Yes; they are no use to them, as it were; no further than ascertaining whether there be this inflammable air.

Lunæ, 13° *die Julii*, 1835.

JOSEPH PEASE, ESQUIRE, IN THE CHAIR.

Mr. *John Roberts*, called in; and further Examined.

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3491. YOU are aware that your partner, Mr. Upton, has already produced to this Committee a lamp which he considers to be an improvement upon the Davy-lamp?—Yes.

3492. Do you agree with your partner, Mr. Upton, as to the merits of that lamp?—I do.

3493. Do you think that the glass lens would not be found expensive in the use, nor that it would be objected to by the workmen?—The glass chimney, as I call the lens, would not be more than 6 *d.*

3494. Do you consider the breakage would be frequent?—Very seldom.

3495. And you are of opinion that that lamp would be found much safer than the lamp originally in use?—Decidedly so.

3496. Now, have you had any opportunity of trying that lamp in any of the mines of this country?—I tried it in the mines of Staffordshire.

3497. Was the mine in which you tried it very foul?—I got the inflammable air as high as I could well get it, out of what is called the sump, a passage they work up to ventilate the thick coal in Staffordshire.

3498. And were you able to explode the surrounding gas from that lamp?—I tried all methods that I possibly could bethink myself of, but failed in doing so.

3499. Were you at Dudley, in March 1834?—I was.

3500. Did you then receive a certificate from certain workmen or parties employed in the mines, as to the results of the experiments which you had made with your lamp?—Yes.

3501. Do you believe that to be the certificate which you received?—I believe it is.

3502. This certificate purports to be signed by 18 men who witnessed your experiment?—Yes.

3503. It states "We, the undersigned, hereby certify that we have witnessed experiments on the safety of two lamps with the fire-damp, or what is here called sulphur. On the inflammable air being brought to act on the Davy-lamp, the flame passed through the wire gauze and ignited the gas outside; the same trial was made on Upton & Roberts' improved lamp, but the flame would not pass from it." That is the certificate?—Yes.

3504. How was the experiment tried?—Gas was forced in the apertures at the bottom where air passes to feed the lamp.

3505. You forced it through the orifice at the bottom of the lamp, and no explosion took place?—None.

3506. You forced the gas through Sir Humphrey Davy's lamp, and an explosion did take place?—Yes; and an explosion took place.

3507. This was in the bottom of the mine?—Both at the bottom and the top. The gas was brought out in bladders, so that the gentlemen belonging to the mines might see it.

3508. But you did not perform the experiment in the mine?—I performed the experiment

experiment in the mine with a bladder of gas in the same way as I did in his own house, but not in the works.

3509. But that experiment in the mine was in a free and clear part of the mine with a bladder of gas brought from the foul air?—Yes.

3510. Have you ever tried by agitating the gas in a large vessel to cause an explosion of the lamp?—I have never tried it in a large vessel; in none larger than what Sir Humphrey Davy and other professional men have described, when I have seen them give their lectures. The lamp has been passed down into a jar of this mixture of coal gas and air, and no explosion has taken place; but I have frequently told them that that was not the way to try it for the mines. Dr. Turner, of the London University, I spoke to on this subject. I told him that the miners had perhaps a hundred times during the day to move the lamp quickly through the air, which was a very different trial for the lamp than what it received when placed in the jar. When the lamp is placed in the jar, the great quantity of carbonic acid formed by the oil and wick, and which rushes out from all parts of the wire gauze, destroys the inflammability of the gas, and therefore it is not a proper test to put its safety to a just proof; but taking the lamp so [*moving it horizontally*] in the mines, moves out the carbonic acid or nitrogen, and the lamp becomes so rapidly heated, that it is no longer a safe lamp; for even when there is no flame discernible, the gas will sometimes be ignited. The wire cage of the Davy-lamp, when filled with flame, as it always is in an inflammable atmosphere, becomes red hot, and will ignite from the coal dust that is floating in the air in the mine, which is sometimes very light, and is floating about in large quantities.

3511. But supposing that the air was so foul in the mine as to burn in the cylinder of the lamp, do you think any explosion would take place without a further mixture of atmospheric air, so as to produce a detonation?—I believe that the lamp would explode in a very short time, providing it was placed in that situation where there was a current of fresh air meeting with the inflammatory matter.

3512. But supposing that there was no current save foul air, do you think the lamp would explode?—I have never tried it myself so, but I have been told by a steward of Squire Willis's colliery, near Prescott, Lancashire, that a safety lamp had been introduced (a Davy-lamp) in that colliery, and that he looked at it and said, "It will be very strange if this be safe; if this thin wire gauze is such a protection as to keep itself below the heating point of ignition." He then took the lamp, and placed it up where the inflammable air was, and after a few minutes had elapsed, there was an explosion.

3513. But you have no means of knowing whether that lamp was in other respects perfect?—No; but I have reason to believe, as it was taken for trial, that it was.

3514. Have you any remarks to make on the subject of safety lamps generally?—Not farther than to state that I have long endeavoured to remove so great an evil as an insecure lamp. This lamp is the most perfect, I consider, I have made.—[*Producing one.*]

3515. That is similar in principle to the one already produced and explained by your partner, Mr. Upton?—Yes.

3516. Did you meet with accidents from carbonic acid gas while you were at Newbottle colliery?—On one occasion I had nearly met with an accident. In the shaft there were two very large furnaces to draw the foul air out, and to cause a quick current of air to circulate through the works. At this time the firemen, who took care of the furnaces, had thrown a fresh supply of fuel on them; on descending the shaft from this circumstance I was nearly suffocated. It struck me at the moment to wrap my jacket round my face; it happened to be very moist, and when I got to the bottom of the shaft I found I was very comfortable, and a sudden change had taken place in the apparent state of the air. Sometime after I was thinking over the matter, and it occurred to me that the cause was the woollen, and the perspiration with which it was saturated, that preserved me in this instance. From trying further experiments in the same shaft, I found it was the woollen which I then moistened with my bottle of water. I often used to be turning this matter over in my mind, and was led to make an apparatus to prevent accidents from suffocation, and thus enable the workmen to work, and to have the use of their hands and eyes in an impure atmosphere.

 3517. Was

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3517. Was any instrument for the purpose of furnishing respirable air the result of your consideration?—Yes.

3518. Now will you explain what that instrument is?—It is called a Safety-hood, or Roberts's Mouth-piece. Lord Lindsey, now the Earl of Balcarras, gave it that name.

3519. His Lordship applied that name to it?—Yes.

3520. Will you explain as concisely as possible the nature, the form, and construction of that hood?—The hood closes over the head, with two glass goggles for the sight.

3521. Of what is it made?—Of wash leather, and stuffed with wool and horse-hair, so as to make it pliable round the neck, and prevent any foul air drawing underneath. From the mouth there is an elastic pipe which comes a little way down, at the end of which pipe there is a vessel containing lime water (the cream of lime), or chloride of lime, according to the kind of vapour it might have to meet, or be expected to meet. These solutions are applied in various chemical works, the chloride of lime, cream of lime, soap lees, even clear water is good. This will take up choke-damp and many kinds of foul air rapidly, and neutralize them so as to enable a person to remain half a day where another could not otherwise remain two minutes.

3522. Now what is the size of the vessel holding any of those liquid preparations to which you have alluded?—It will hold about three quarts; there is some sponge which is filled with it, so that the air shall pass through fine apertures.

3523. Is it one solid sponge, or pieces of sponge?—It is immaterial whether the sponge is in one piece or several.

3524. Then the funnel or box in which the sponge is contained, is perforated with holes?—Yes, there are small tubes for the air to go down, and by continually passing it through this solution, the foul parts adhere to the sponge and to the lime.

3525. Then does the box with the preparation hang from the end of the tube, does it drag along the floor, or is it carried by the man using it?—It is carried with a belt over the shoulder; it hangs down over the side, so that there is no pressure from the neck, like a soldier's belt.

3526. Now is respiration kept up by the men using it with tolerable facility?—Yes; when first invented it was rather difficult. Persons using it could not remain with it more than half an hour at the longest.

3527. And have you improved upon its construction since that time?—Yes; I have improved it so that a person can work day by day without feeling any inconvenience; it is also on a lighter scale now.

3528. Now have you tried it yourself in carbonic acid gas?—I have tried it myself where no other person could exist one minute without it. I have remained 39 minutes.

3529. You apprehend that you have tried it in places where the carbonic gas was in such quantities, and so powerful, as would immediately extinguish life?—Yes.

3530. And you found no difficulty in the experiment?—Some little difficulty then; but since I have made a very great improvement in its construction, and should now feel none. The improvement is this: the air which has been respired is not suffered to go back to the small vessel, where the good air is separated from the bad; it is thrown out by means of a valve at the front of the mouth, or rather there are two valves, one is to admit a supply of purified air, and the other to pass off the air which has been respired.

3531. Now have you ever had this instrument tried in foul wells?—I have not been in foul wells.

3532. Have you ever tried it in cases of fires?—I have tried it in cases of fires, also in the mines.

3533. Has it ever been tried in the case of any fire in this city?—It has been tried by some of the firemen; it has also been tried at the large refining works belonging to Mr. Browne in Wood-street. His men have had three supplies from me, to prevent their inhaling the nitrous acid which arises from driving off the copper from the gold. It is very pernicious when the atmosphere is heavy, or when the furnace does not draw well. In such cases the place is filled with this deleterious vapour which causes a sensation of coughing, and places the people very often under the doctor's hands, and in the end kills them.

3534. And have Mr. Browne's workmen used this instrument?—Yes.

3535. Did

3535. Did they find any advantage from it?—They found such great advantage that, when I was down at Bolton in Lancashire, as the hoods were worn out, they applied to my friend Mr. Upton for others, he being in London, which I was not. It was necessary to pay them higher wages to work in this place till they got the hoods, as they were frequently very ill from the fumes from the metal.

3536. Do you mean to say the workmen had constantly made use of your invention?—Yes, and they were wanting it to be renewed. Since then a plan has been brought forward of a platina vessel dissolving gold, over which there is placed a funnel to carry off the fumes. This has enabled Mr. Browne's workmen to do without the hoods, but they are however still used in various chemical works in different parts of England.

3537. Then they are now constantly in use on the improved plan?—I have not sent out any on the improved plan as yet.

3538. But you have no doubt it will be found a great improvement whenever it comes to be used?—A very great improvement.

3539. Now would you hesitate to descend any mine charged with carbonic acid gas after an explosion, provided with this apparatus, to draw out the bodies of the sufferers?—No, I would not.

3540. That is, you have full confidence that you would be able to prosecute your search for any person who has suffered without risk to yourself?—Yes; and I am so confident of it, that if they were in a torpid state I could fetch them out of it, were a mine distant.

3541. Are you aware of your first apparatus being tried in France?—Yes.

3542. Where was it tried?—I tried it under the ground on which the Bastile had stood.

3543. Was that in some sewers or underground excavations?—It was in a sewer that had been closed for 37 years.

3544. Had other workmen failed in entering that aperture?—Yes, they had made an attempt 15 years previous.

3545. Did you succeed in entering it?—I succeeded, when D'Arcy, the great chemist, failed in his attempt to enter it, or to enable others to do so.

3546. Was the object to cleanse the current?—Yes, and to communicate with other sewers, so that they might make it useful to that part of the city.

3547. And by the aid of your instrument was the object obtained?—Yes.

3548. Since then you have improved upon it considerably?—Yes, very considerably.

3549. Then you would recommend every mine subject to carbonic acid gas to be provided with your apparatus?—Yes, for fear of accidents from mephitic air.

3550. You are familiar with the circumstance named by a former witness, which took place at Newbottle colliery; are you of opinion that the lives of those individuals who suffered with Mr. Steel might have been saved if your apparatus had been at hand?—Yes, decidedly so; he and the others might have been saved.

3551. You do not put any lime into the water when you go into places filled with smoke, do you?—They may put lime or soap, soap-lees, or rub the sponge over with soap, and when it is immersed in water it is saturated in a moment.

3552. What is the price of your apparatus now?—It will be about 4 *l.* complete, 4 *l.* or 5 *l.*; I cannot say to 1 *l.* on this new construction.

3553. One was purchased of you at four guineas?—Yes.

3554. Have you had a reward for this invention?—I received 50 guineas from the Society of Arts, and their large silver medal. His Majesty King George IV. rewarded me with his royal bounty of 100 *l.*

John Newman, Esq., called in; and Examined.

3555. I BELIEVE you are extensively engaged as a manufacturer of lamps?—I have been formerly, but not at present. I made them originally for Sir Humphrey Davy, and under his direction.

3556. You were from time to time in conference with Sir Humphrey Davy as a manufacturer of lamps, at the time he was prosecuting his inquiries?—Constantly during his inquiries.

3557. And you were the maker of those lamps which he first sent into the north of England, I believe?—I was.

3558. Has your attention been recently called again to the subject, in consequence

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quence of this inquiry, and other occurrences connected with the mines in this country?—It has, very recently.

3559. Have you, from facts that have come to your knowledge, been led to make any alteration, or to propose any alteration in the lamp, as originally produced by Sir Humphrey Davy?—I have.

3560. Will you give the Committee your ideas upon that subject?—I wish to remark that a great deal has lately been said in the various prints of the unsafety of the miner's lamp of Sir Humphrey Davy, without endeavouring to show by any philosophical reasoning why or how it is unsafe; and some experiments have been shown, endeavouring also to prove the same point, without any adequate explanation; few persons seem to be aware of the principle, and in consequence are led to form erroneous opinions. I will endeavour, in as few words as possible, to show the fallacy of what has been said and done, and, I hope, convince the Committee of the great reliance that can be placed upon it. The Committee is doubtless familiar with the form and mechanical construction, which consists of a lamp, the wick of which is surrounded by a medium of wire gauze of certain size apertures, the object of which is to prevent the flame of the lamp from communicating with the surrounding atmosphere, and preventing its taking fire. Many persons also are familiar with the appearance which takes place when the lamp is introduced into such an atmosphere. But I will endeavour to state what those appearances are, and the effect. Upon first introducing the lamp the flame is considerably lengthened, a pale blue flame begins to burn in the interior of the cylinder, the intensity of this flame increases, the cylinder becomes of a dull red heat; if you remove the top covering of the lamp you cause a greater current through the gauze, and thereby increase the intensity of the flame, by which means you can obtain a strong red heat; the greatest heat to be so obtained is not sufficient to inflame the surrounding atmosphere, nor is any motion you can give to the lamp in such an atmosphere sufficient to propel the flame in the interior through the surrounding wire gauze; the opposite effect is produced by giving motion to the lamp in such an atmosphere, the wire gauze is cooled down and the lamp goes out, the flame burning feebly in the cylinder being mixed with carbonic acid, the rapid current puts it out. I am aware that some experiments have been shown, by which means the flame has been made to pass the wire gauze when heated; but those experiments, I apprehend, cannot be made, or the effect produced, unless you can remove the lamp from an explosive mixture into the open atmospheric air, you then disengage the foul air from the lamp, and charge the cylinder with atmospheric air, and by again bringing the lamp into the explosive mixture, an explosion or detonation takes place in the interior of the cylinder, and the flame is driven or forced through the gauze. Now this effect cannot take place in the foul part of a coal mine where the lamp is burning with the wire gauze at a dull red heat, the whole atmosphere is in that case explosive; you cannot instantly remove the lamp into the open atmosphere, and charge the cylinder, so that when you again hold the lamp steady, you obtain an explosion sufficiently powerful to drive the flame through the wire gauze. The atmosphere you are in will not form the mixture, but the lamp will again begin to burn with a pale blue flame without any explosion. It is the forming of this violent detonating mixture, by means of atmospheric air that you drive the flame through the sieve, and the heat of the sieve must be in proportion to the violence of the mixture, for unless the sieve is very hot, the cooling power is so great it will not suffer it to pass. Hence my opinion is, that whilst any chemist may show the experiment I have alluded to, it is not a practical result to be anticipated in a foul mine. Having explained the effect of the lamp, and some of the objections, I beg to lay before the Committee an alteration I have made. Well knowing that the cylinder recommended by Sir Humphrey Davy, when heated to a strong red heat, is not sufficient to explode a mixture of atmospheric air and carburetted hydrogen, and that such a mixture exploded in a cool cylinder will not pass, my object has been to keep the cylinder as cold as possible, by surrounding it with a second gauze, leaving a space of about a quarter of an inch between. This outer cylinder is made to slide up and down at pleasure, so as not to obstruct any light if so required, or to be brought down covering the whole of the lower part of the interior cylinder; opposite the flame does not require covering; a current of air passing through this part of the sieve, whether atmospheric air or carburetted hydrogen, puts the lamp out; it does not become very hot; it is the upper part, if any, requires protection. This upper

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part being surrounded by another cylinder at a short distance; a current of air passing between the two, keeps the outer, and likewise the interior cylinder cool; and should perchance the lamp get quickly into a very explosive mixture, where the detonation in the interior cylinder is so great as to make it pass the first, the quantity of air between the two cylinders being small, and not sufficient to heat the outer one, it is, I consider, impossible to make the flame pass the whole. I have submitted this lamp to the most severe trials, and I find if the top of the cylinder is covered I cannot produce any heat in the cylinders, the stream of gas is driven down and the lamp extinguished. Upon removing the top, the heat is very much increased, but not so much as with a single wire gauze, for the double cylinder obstructs the rapidity of the current, and the heat produced in the upper part of the cylinder is in proportion to the facility with which the current can pass. After a number of trials with a large quantity of gas issuing under considerable pressure from a large aperture, I once succeeded in causing the flame, by explosion, to pass the interior cylinder; the gas then burned between the two cylinders with a pale blue flame, with little intensity, not apparently producing any increased heat, only a glow of light; this was soon extinguished by a more rapid current of gas. I flatter myself I have so far succeeded as to make the lamp of Sir Humphrey Davy doubly safe; and those persons who are doubtful of the naked cylinder, can at a trifling expense ensure safety by applying an outer one. Sir Humphrey Davy recommended the twilled thick wire gauze to be used, and by limiting the size of the cylinder, make the quantity of flame not sufficient to heat the whole surface, only the top, which he guarded by an upper cylinder. I would remark, the twilled gauze was also liable to be strongly heated. The light I have not found to be materially diminished by the use of the double cylinder of gauze. I do not propose to cover the whole of the cylinder by sliding down the outer circle, except in extreme cases. This outer cylinder is also a great protection to the accumulated soot in the upper part, as no ignited particles can escape it.

[*The Witness produced a lamp constructed as described in the foregoing answer.*]

3561. Has Mr. Buddle, or any gentleman connected with the mining interest, seen this lamp?—I showed it to Mr. Buddle on Saturday, previous to his going out of town.

3562. Did he give any opinion upon the lamp?—He thought very favourably of it.

3563. Did he make any remarks as to the quantity of light?—He did not, for I explained to him that the great light issued from the lower part of the cylinder, and that it did not obstruct hardly any light.

3564. Is your theory that the rays of light from such a lamp are horizontal?—The greater portion of those rays pass horizontally.

3565. And that the upper part of the lamp admits very feeble light as compared with the lower part?—Certainly; more especially when surrounded with the wire gauze, as it is in this instance, because this upper part is always charged more or less with the soot, which impedes the light very much, while the lower part remains clean.

3566. Was the gas that you used in your experiments similar to that which is burnt in our streets?—The same.

3567. Were you unable to explode the lamp from a jet of that gas?—I was.

3568. Do you apprehend Sir Humphrey Davy's lamp would have exploded under the like experiment?—It would with the naked cylinder.

3569. The addition proposed by you might be made to the lamps now in use?—I consider very easily, at a very trifling expense.

3570. Can you conceive any objection to the use of your lamp, save and except that of the assumption of diminished light?—I do not consider that there is perceptibly any diminished light.

3571. Have you tried it in a dark room, as compared with the original lamp?—I have.

3572. And your opinion is, that the miners would have no occasion to find fault with the diminished quantity of light?—I do not consider that they would have any occasion to find fault with it. I consider the light equal to any purpose they might require it for.

3573. Sir Humphrey Davy's lamps were made in the first instance with a glass

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lens, were they not?—I applied a glass lens to some of Sir Humphrey Davy's lamps.

3574. At his request?—At my own suggestion.

3575. Did Sir Humphrey Davy ever make any remark on the application of the glass lens?—He stated that it increased the light at a distance from the lamp.

3576. Had he any objection to make to the use of it?—Not in the least, I never heard him object to it. The only objection that was ever made against the lens was the extra expense attending the application.

3577. But if Sir Humphrey Davy was aware that a violent current might cause an explosion with his lamp, must he not have approved of the additional safety procured by the use of the lens?—He never made any remarks upon it.

3578. But Sir Humphrey Davy was aware that a sudden current would explode a foul atmosphere surrounding his lamp?—It must be a very violent impulse, and the sieve must be at the time very hot or the flame will not pass it.

3579. What might be the additional expense of the addition of the outer cylinder?—I should think it might be applied for about 1 *s.* 6 *d.*; it is very trifling; the lamp is in every respect the same, independent of the outer cylinder.

3580. And after being used a considerable length of time, would it on its present simple construction retain its placé when forced up?—Yes, I should think so; and with great facility this outer cylinder may be removed, drawn through and cleaned and put into its place again, in the same way that they now clean the interior one. The outer cylinder may be withdrawn with great facility; this aperture is not sufficiently large to enable me to draw it up now, but it might be drawn up, and with a small brush they might clean the exterior at the same time as they clean the interior, the inner cylinder.

3581. And the Committee are to understand, that in the experiments where the detonation took place the gas never passed both cylinders?—Never.

3582. That no force obtainable from the jet of gas as carried into houses, could be made to explode a surrounding atmosphere of inflammable air?—No; the effect of a strong current of gas upon a lamp always puts it out. When the upper part is closed, if you pass the current of gas through the upper part here, it is propelled down upon the flame and puts the lamp out. It is always the effect of a strong current of gas.

3583. Is that an immediate consequence?—I found it so. The flame will not burn in a rapid current; the same with the gas lights in the street, when there is a rapid current passing across, they go out. So it is here; the rapid current of gas passing into it, it is propelled down, and the lamp is put out.

3584. But that is atmospheric air from a street lamp; does the same observation hold good with carburetted hydrogen gas?—It is of carburetted hydrogen I am speaking; the carburetted hydrogen passing into this. If you pass a quantity of gas through this part of the sieve when the lamp is burning, you will put the lamp out. Pass it slowly in, it begins to burn with a pale flame; but if the current is too rapid, you put your lamp out.

3585. Then the theory is, if these lamps have ever exploded in any of the mines, it has been by a sudden detonation, owing to the admixture of atmospheric air in given proportions?—I consider so.

3586. And according to the strength of that detonation or explosion, so the surrounding atmosphere is ignited?—Certainly. If you could remove it from the atmospheric air into an atmosphere of pure hydrogen, you would get then a violent detonation; the flame would be made to pass through the wire gauze, however thick, or however small the aperture.

3587. Do you wish to state anything further to the Committee?—No; I am not aware of anything else.

John Garforth, Esq., called in; and Examined.

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3588. YOU are a proprietor of coal mines in the county of Lancaster?—No; I am not a proprietor; I have the management of large coal works belonging to Messrs. Lees, Jones, & Booth.

3589. Where are these coal works situated?—In the parish of Ashton-under-Lyne.

3590. What is the depth of the shafts?—We have them 250 and 318 yards.

3591. Is more than one seam or bed of coal worked from those shafts?—No.

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3592. What is the thickness of the bed of coal?—Four feet; four feet two or three sometimes.

3593. Of what nature is the roof and floor of the mine?—It is a good floor, but the roof is not a good one.

3594. Are they of stone?—No; it is a kind of metal; a shell; what some folks call soap-stone collieries.

3595. Now are you, in the working of those mines, annoyed by the infusion of carburetted hydrogen gas?—Yes.

3596. Does it ever prevent your prosecuting your work in the mine?—A little sometimes.

3597. Is the mine ever laid off for days and weeks?—No.

3598. Are there any particular states of the weather in which you are more annoyed with the gas than others?—I have seen that the case in some parts in my lifetime.

3599. But in the mines now under notice is it the case, that in summer or autumn there is a greater effusion of gas than in winter and spring?—In summer there is.

3600. Have you had any accidents in those mines?—Yes.

3601. Did they take place in summer or autumn, or at what season of the year?—I think it was spring.

3602. What is the date of the most recent accident?—It is four years, I think, since we had one man killed; but we frequently have them burnt.

3603. Has there been no fatal accident in the neighbourhood of Ashton within four years?—Not by the fire-damp, I think.

3604. From any other cause have you had any fatal accident in your neighbourhood recently?—Yes, I think we have.

3605. Have the goodness to state to the Committee how that accident was occasioned?—It was a man that was doing something at the engine.

3606. Now when you are aware that your mines are in a foul state, which way do you proceed to clear them?—There is no way of clearing them but getting as much of the atmospheric air in as we can.

3607. And how do you proceed; do you use the furnace under ground?—Yes, we do.

3608. Have you a system of air-coursings all the way through your works?—Where we are working.

3609. Do you work your mine twice or once?—Once. It may be called twice, because there is the driving the levels, and then bringing the pillars back when they are got to the far end.

3610. Do you make a point, after sinking your shaft, of driving to the limits or boundaries of the field which you have won by that shaft?—No; the mine lies steer a yard at two, and we perhaps lose 80 or 90 yards at a time; that those are brought down to the level by a machine down an inclined plane, and when the coals are all got down, we sink again and tunnel out on the dip to win a fresh breadth. If we can double those we do, and let them down at twice. We have a machine commonly called a jig, we let them down by a break; there are two roads, one has a balance to wind up, the top goes down, and then when we fill the tub it is put on to the carriage, and when it goes down again it fetches the balance up.

3611. Is it what is called a self-acting plan?—No, not self-acting altogether; there is somebody to attend to it.

3612. They break down?—Yes, they break down.

3613. Now in working any section of the mine, whether it be 80 yards in extent, or from that to 160, are you more annoyed with the gas in pillar work or when in the whole coal?—I do not know that we are.

3614. Does the gas in your mine seem to come from the coal, or partly from the floor and roof?—It comes in the coal.

3615. Have you an increased quantity of gas when the roof of the mine falls?—I do not know that we have.

3616. Is your seam of coal very much broken up by backs or cracks?—We have a good deal of them.

3617. Do you find those backs or cracks generally loaded with gas?—Yes.

3618. Are there any indications in the coal to show when you are approaching those backs; do you know when to expect to meet with them?—Sometimes as the collier

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collier is working they will crack; there will be a noise, a crack in the roof too sometimes.

3619. Then does the gas rush out with great force upon the miner?—I do not know that it does exactly so, but it does increase the quantity.

3620. Now in consequence of having so much of this gas, are you under the necessity of using lamps?—Yes.

3621. On Sir Humphrey Davy's principle?—Yes.

3622. Have you any naked lights at all in the mine?—Yes. I do not consider we go to that extent that they do at some collieries.

3623. Do you confine the use of lamps to the spots where the men are working?—Yes.

3624. Do you ever allow the hewers the use of naked lamps in what is called the boards?—Yes.

3625. Have the drawers naked lamps?—Yes.

3626. Have you ever had any accidents from the use of naked lamps?—What accidents there have been have been from naked lamps.

3627. What is the objection to using lamps where you now use naked lamps?—I consider the expense would be increased.

3628. Is oil in the lamp more expensive than the miner's candle?—I do not know that it is; but the men could not work so well by a lamp as a candle.

3629. Do the hewers complain of being compelled to use the lamp in cases where they think they are safe with the candle?—I do not know that they do; but as I said before, we do not go to that extent with them; we may have some particular places where there may be a good deal of gas, and we may use a lamp for a week or two till it is finished, or perhaps a month, but not the whole pit working together with lamps.

3630. Now do they expect more price when they are working with the lamp?—They would, if it were general.

3631. Are there any pits in your neighbourhood where they work altogether with the lamps?—I think not.

3632. Why would they expect a greater price?—Because it does not give so good a light as a candle.

3633. They could not get so much money?—No, they could not. I think a collier would get more by 6 *d.* a day by a candle, than he would by a lamp.

3634. That is, by being able to follow the cracks, and to put in his tool right?—Yes.

3635. Have you ever visited the mines of Durham and Northumberland?—I have not.

3636. Are you aware that in some of those mines the men work altogether with the lamps?—Yes.

3637. Are you aware that the same price is paid for hewing by lamp-light as by candle-light?—No, I am not aware of that.

3638. Do you suppose, from your own knowledge, that after being accustomed to the lamp, a man would find any great difference in hewing with a lamp and with a candle?—I think he would; I think he would not like it.

3639. The question is, would he really find any difference; you go down the mine occasionally?—I do; I have four underlookers, and I go myself; if there is anything I cannot understand, I have them all together, and if they do not satisfy me, I go down myself.

3640. Whenever anything appears amiss in the mine, you make a personal view of it?—I do.

3641. Well, now, when men have been burnt, has it happened to more than one man or two men at one time?—We had one man ill burnt and he died of his wounds, and there was a boy with him. The boy is alive yet. It is some three or four years since, and it was through his own carelessness. He was working in a level, and he went in and held his candle too high.

3642. Then you are never able effectually to keep the gas under by your system of ventilation?—Not entirely so. The next we had was by a break in the old work, it fell and drove the foul air upon them; there were two or three burnt, and two killed dead at the spot. That is the last that we had.

3643. Were they working with candles?—They were.

3644. Now, had not that accident any effect in making the men wish for lamps?—I think we only began some time about then using them.

3645. How long is that ago?—Three or four or five years. I got some from Newcastle

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Newcastle from Mr. Bramley's agent, being acquainted with him at Middleton colliery, near Leeds.

3646. Do not you think it would be an act of kindness to enforce the constant use of the lamps in your mine?—I think there is a better way.

3647. Now, will you tell the Committee what you think is that better way?—Sink more shafts; there will nothing else do; I have been acquainted with it all my life, from 10 years old, and I am now approaching 70. I durst have trusted to my own experience before I was 20 before any other man's. I was employed to assist as underlooker; I had something for it, and did my own work at the same time, the same as another collier; and when I was 29 I was sent to manage a concern, and I did that about 19 years, in Yorkshire; and it will be 19 years in November since I came to Ashton-under-Lyne.

3648. Do you mean to say that a mine cannot be safely ventilated for 80 to 160 yards in your country from one shaft?—If they make a partition it can.

3649. Are you in the habit of putting in a brattice or partition?—The time that we are sinking we do; but as soon as it gets down we ventilate it from another shaft.

3650. And how often do you sink your shafts; that is, what extent of coal in acres would you propose in a general way to clear from one shaft?—I cannot speak to that exactly. The colliery is situated in this way, we have pits at a short distance from both ends, so that the air has never a long way to pass; say five miles, not more than that.

3651. But what distance are your pits generally from each other on the same level?—Why, near a mile; but then we have two together; we have two or three. The mine rises, as I told you, a yard at two, and we have two or sometimes three together, and one will ventilate another.

3652. You do not drive a level of a mile from one pit to another?—Oh, no; they are driven both ways.

3653. Then, in point of fact, you always have one or two upcast shafts, and one or two downcast shafts?—I should like, if we could, to have two down shafts for one up; that gives a greater quantity of atmospheric air.

3654. Have you ever found any difficulty in forcing a sufficient quantity of air down one shaft?—I think, sometimes I have been put to it. The means we use is to make the furnace larger.

3655. But you always succeeded by enlarging the furnace in obtaining an adequate current of air?—Yes.

3656. Now, if you had a sufficient current of air, what good would it do to sink more shafts?—They cannot get a sufficient quantity of air to bring the gas out if they have not shafts.

3657. If you can produce as much air as the candles can burn in, how could you use more?—Well, if that air is laden with sulphur and gas; if it were laden with that, they might load a steam engine while it could not work.

3658. If the current is so strong as that you cannot keep your lights burning, could you do with a stronger current?—No, perhaps not with a stronger but a better.

3659. Could you do more than fill the area with some kind of gas, foul or free?—Well, atmospheric air would be better than that.

3660. Is it possible to divide the two in the same way?—Do you mean splitting the air?

3661. I want to know, suppose your gateway is full of air, can you do more than fill it?—I have known it to be full many a time when we could not keep a candle in it; it has been laden at the same time with sulphur, and that is the very cause that so many men lose their lives.

3662. Do your accidents take place in the gateway?—I think seldom there.

3663. Did you ever know an accident take place in the gateway?—Why, I heard once of a careless fellow, I did not see it, but I worked at the same place; he laid on his back, and he wrote his name with a candle, or was trying to do so, on the roof, and it fired on him at the gateway.

3664. That was wilful?—Wilful; and 15 out of 20 of the accidents that I have known have been through carelessness.

3665. Do you endeavour to draw the foul air off through one coursing, and to keep the free air upon the men at work?—We cannot separate them.

3666. Cannot you conduct two lines of air coursing through the same colliery,

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using sufficient stoppings and doors?—We have two lines always; it goes on one, and comes back on another.

3667. But do you ever split the air, taking one course through the foulest parts of the mine where very little work is doing, and keeping a free air course upon the men who are at work, clearing on in a different part of the upcast shaft?—I do not consider it at all times to be practicable to do that, because, for this reason, if one has a shorter length to go, and the other a longer, the shorter will have a smarter draught, and perhaps the other will have less when more is wanted.

3668. Cannot you regulate that by doors?—We have doors.

3669. Cannot you regulate it to a great nicety by the use of the doors?—I think not altogether so.

3670. Cannot you in point of fact turn it first one way and then another?—Yes, we can do so.

3671. Then supposing you want to pass a strong current along the face of a waste, or where you have found more gas than in other parts of the mine, could you not do it in the way just mentioned?—I think not; it would not be so safe. Where I have any danger or difficulty, I generally produce all the strength I can to manage it.

3672. Are you troubled with the gas rushing from the wastes?—Not so much of that as they have where mines are flat.

3673. In point of fact, you have a great advantage from the gas being specifically lighter, arising from the upper part of the mine?—Yes, when coal is gotten above it fills up with black damp; it will serve as well as a wall; if it gets on further it smothers itself.

3674. Is the black damp hotter or heavier than atmospheric air?—Heavier.

3675. Then how would you distinguish it from descending from the lower levels?—We have a sufficient quantity of air to take it out; but we do not want air to go up there when we have done with it.

3676. Then it is the chasms you want filled with black damp, and not with carburetted hydrogen?—It is the old waste that gets full of black damp.

3677. Now in pillar working how do you manage to ventilate that?—Generally two are together; and as the wind goes up one, it comes down the other.

3678. How many men may you have at work taking away the pillars in one mine at the same time?—Perhaps five or six, or seven. I have known eight.

3679. Now putting yourself in the situation of these men in every respect, the Committee wish to repeat the question whether you would not think the master justified in forcing them to use the lamp?—I think he would not. The colliers are very masterful in Lancashire. If that were applied, I think there would be a strike.

3680. They would rather that one or two were blown up every year than they would use the lamp always?—Perhaps not so.

3681. They know that there is some risk always from using candles?—Yes, there is.

3682. And they do not apprehend there is any risk from the lamp?—No, they do not; they are well satisfied with Sir Humphrey Davy's lamp.

3683. You have had no accident from lamps?—None at all. If they get where there is any sulphur hardly, it begins to spindle up, and go a little further and it fills chuck full and goes out, and I would not suffer them to work with it so.

3684. Do you know whether they smoke in your pits?—A good deal.

3685. Did you ever see them lighting their pipes at the lamp?—I do not know that I have.

3686. If a man were to suck the flame through the lamp to his pipe, what would be the consequence do you imagine?—I think he would be running some risk.

3687. Do you think he would be certain to blow up the mine?—Most likely he would; but I would not suffer it if I knew it.

3688. Do you allow them to take their pipes down at all?—Yes, we do.

3689. Do you know they are prohibited in many mines in the north of England?—Yes; but we have not had occasion to take that precaution.

3690. But do you not think it would be wise to prohibit them in your mines?—Perhaps it would.

3691. Do you think a little tobacco smoking could justify the risk that must be run in case they do light their pipes?—Perhaps it would be better to be without them. There has only been three in 19 years; it has not been so bad as some.

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When these two were killed, I believe if they had had Davy's lamp it would not have happened.

3692. But still you think that the men would have grumbled if they had been forced to use them?—I think perhaps not. We can manage two or three somewhat better than a whole pit, or four or five pits.

3693. How many men have you employed altogether in the mines under your care, men and boys?—Between 400 and 500.

3694. And on an average, how many lamps may you have in use generally?—I think there is not above half a score.

3695. The pitmen's objection to the use of the Davy-lamp is in the belief that they cannot do so good a day's work?—Yes.

3696. What is the average quantity of coal that a collier will work by the naked light in your pits?—Well, in a pillar, he will get perhaps four tons.

3697. In the whole coal, how much?—Three.

3698. If it were made apparent to the pitmen that they might, by a little practice, do as good a day's work by the use of the Davy, do you think they would retain the same objection?—I am not able to answer that.

3699. Are your men in the union?—I think not; I would hope they have got cured of that four years since. I would not employ one that was in it, if I knew it. Every man I set on, that question is asked.

3700. Are you acquainted with the mines about Wigan?—I am not.

3701. About Oldham?—Yes; I know a little about there, because we are getting the same mines nearly.

3702. They are very much the same as to danger that yours are?—Yes.

3703. They are not so steep as yours?—No, not so steer.

3704. They are more steer than any in your neighbourhood?—At Duckingfield, they are more than ours, I think.

3705. Now, are there any mines round about you considered more dangerous than your own?—I do not know that there are.

3706. Accidents have not been more common than with you?—I think not; not with fire-damp.

3707. Do you suppose you lose five men a year in the district, by explosion?—I think not.

3708. Three?—No, nor three, I think, to the best of my knowledge.

3709. Are you acquainted with the mine at Saint Helen's, in which it is reported 17 persons were drowned the other day?—No; I never heard of it before I came hither.

3710. Do you know at all the number of pitmen that are employed in that district?—No, I do not.

3711. Not exactly; but can you give any approach to the number?—No, I cannot. There are a good many small concerns.

3712. Throughout the district are there as many as 1,200?—I think not more than 1,200; but if Duckingfield be included, there will be 2,000.

3713. You allude to Duckingfield when you say three, do not you?—Yes, I do.

3714. Are there many crippled from being seriously burnt?—I do not know that there are.

3715. Are you acquainted with the mines in any other part of the kingdom?—In the mines about Wakefield, I was brought up there under Mr. Fenton, while I was 29 years old, or perhaps better.

3716. Are you acquainted with their present state?—No.

3717. Were they subject to foul air when you were acquainted with them?—Yes, a great deal; and they are now I believe.

3718. Were there explosions when the safety lamp was not invented?—Yes, there were.

3719. Did many men lose their lives?—Yes; there have a great many lost their lives at times.

3720. Those mines are still working?—Yes.

3721. Have you heard whether they are yet liable to acciden?—Yes, at times they are.

3722. Do you think they use the safety lamp?—I do not know.

3723. You had a meeting of some of the coal proprietors and agents a short time ago, I believe, on this subject?—Yes.

3724. I believe they were so kind as to request you would attend the summons of this Committee?—Yes.

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3725. Did they say whether they proposed to give any evidence as regards the Wigan coal-field?—No; it was thought that you should have somebody from that neighbourhood, but there has been nobody sent for.

3726. Do not you consider those more dangerous than your mines?—I do not know; in those flat mines perhaps there may be more danger, as the atmospheric air is heavier than the gas. After they have done working a place, I could go, or a collier might go, and take a candle and be safe where there is a cloud of danger over him. And I think I can tell, but not exactly where, it is in my recollection somewhere, it has so happened that somebody has gone into their place, I am not alluding to Wigan, but anywhere where the mines are flat they ought to be walled up with brick and lime when they have done with them.

3727. But you are aware that those brick and lime stoppings generally give way in a short time, so as to let the foul air rush out?—There will be a little come through, but it will not come in that quantity to cause a blow up, the air will bring it away as it comes.

3728. Then you think that to force the use of the lamp with you, would render the men dissatisfied, and raise the price of labour, and consequently of the coals?—I think so; that is my opinion.

3729. And do you think anything else can be done, provided there is sufficient shaft room for ventilation?—I do not know that there can; I do not know a better way than having castdown pits enough.

3730. Now in your opinion, is there sufficient attention paid to having a sufficient number of shafts?—I think there is where I am, and in the neighbourhood too.

3731. You do not think the men run any unreasonable risk, through any wish to save money on the part of the owners?—I think not.

3732. Do you ever force the men down when they complain of the pit being foul?—I would not suffer them to go down.

3733. You never knew an instance of a man being required to go to work when he complained of the pit being unsafe?—I think I have in my lifetime, but I cannot say where now.

3734. But you are sure that the case is very rare?—Yes, I am.

3735. You said you introduced the Davy-lamps about four or five years ago?—Yes.

3736. Was it after or before the accident to which you have alluded?—I think it has been since; I believe those two men would have escaped if they had been at work with them.

3737. Do you notice any difference in the foulness of the mines when there is a change of the atmosphere on the surface?—Sometimes I have. For instance, if a pit is at the side of a hill, a castdown pit I will say, and the wind comes over the hill beyond it, it will castdown not so freely as it will another time; and in the same way a castup pit when it comes against it will prevent it.

3738. But not merely with the change of the wind, but the fall or rise in the barometer?—We never use that. I cannot tell anything about that.

3739. Have you noticed whether the accidents occur on any particular day of the week?—Well, I do not know, not at present; I have known formerly, when the furnaces have been let go out on a Saturday night and then lit again on the Monday morning, there has not been such a strong draught all the day on the Sunday and the Sunday night, than when it has been kept in; and sometimes it may have been the case that somebody has been burnt. But I do not know of anybody being killed.

3740. You have a cannel pit, have not you?—Yes.

3741. Is there more or less gas in a cannel pit?—It is as near without as may be.

3742. The bituminous seams are those that yield the most gas?—I wish all others were like those. We have nine pits I think at work, and there are five of them in which we are plagued with gas.

3743. Do you ever lose any men from carbonic acid gas or from black-damp?—No.

3744. After a fire have you no black-damp?—We have not had one.

3745. Does there seem to be an apprehension on the part of the coal proprietors in your neighbourhood lest there should be some legislative enactment following the inquiries of this Committee?—I think there have been some thoughts of the kind.

3746. And they have taken alarm at them?—Yes, rather.

3747. Do you know what they are afraid of?—No. I am, perhaps, saying wrong; they are frightened lest you should make some alteration in the works, and I think there is no occasion for that; only sink pits enough, that is the safest way, and it will be preferable to all lamps.

3748. Do you think it possible for any Act of Parliament to prescribe to a man how he is to work his coal, taking into account the different depths of the shaft, of the seams of coal, of the dip, and the rise of each of those seams, and every other local circumstance?—There would be some difficulty I think.

3749. Do not you think that every man is the best judge of the most economical and safest mode of working his own pit?—Yes, I do.

3750. Would not the frequent sinking of shafts render the expense of working the colliery much greater?—I think they would save it by the lamps.

3751. How?—They would get more coals for the same money; that is my opinion.

3752. Do you mean that by bringing the coals a shorter distance they would raise them so much cheaper as to pay for the extra expense of sinking so many shafts?—That is my opinion.

3753. What is the diameter of your shafts generally?—We have one, I am not certain whether it is 10 ft. 6 in., or 11 feet, that is 250 yards; and we have another that is 11 ft. 6 in., that is 318 yards; we are sinking that lower.

3754. Now, have you any difficulties to contend with from quicksand or great feeders of water in sinking in your country generally?—Yes, we have.

3755. What do you consider a rough estimate of the expense of sinking a shaft 11 feet diameter, 250 yards?—£.5 a yard; it is walled with brick and lime the whole of the way.

3756. Then it would cost from 1,200 *l.* to 1,500 *l.*?—I should suppose it would.

3757. Are you aware that a shaft of the same diameter and to the same depth would, in many districts of the north, cost 50,000 *l.*?—I am not able to speak to that, I have not been there.

3758. Would you not consider that a great obstacle to sinking many shafts?—Where they would cost so much it would; but there is a way to remedy that.

3759. Will you state your remedy?—Lay the price upon the coals; let the public pay for it; who would not give a trifle more rather than have all these men destroyed? I would rather myself if I had them to buy.

3760. Would you consider yourself justified in working a colliery in which 50 or 100 men were destroyed every 10 or 15 years?—I cannot answer that; I think not.

3761. Now, from your experience of flat seams, do you think it is possible with any number of shafts to ventilate the gofe or waste land behind, when that is filled with gas, and the roof and floor are always emitting large quantities?—It would not be possible to keep gas out of that.

3762. Did you know the mines in the neighbourhood of Bradford?—Very well.

3763. Did you consider them dangerous mines when you knew them?—It required some care to manage them; they had a good deal of gas at that place when I was at them.

3764. Did they not frequently explode?—I lost one man there in my time.

3765. Were your neighbours in the habit of losing men?—Sometimes.

3766. Have you heard lately whether they ever lose men?—No.

3767. Do you know whether they ever lose men?—No.

3768. Do you know whether they use the safety-lamp?—I think they do.

3769. Are not the seams there very thin in the bed?—Yes; and the sulphur comes out of the floor.

3770. What is the thinnest seam you ever saw working there?—I think the coal they work the furnaces with is about two feet, and I have seen it as low as 23 inches.

3771. Then do the men work laying on their sides?—Yes.

3772. In the water?—There is no water, it is dry.

3773. Are they all dry, those thin seams?—Not always.

3774. In that case have the men ever to lay in the water?—No, they would have a level; they have their levels, and all the water is drained into them, and they then get to the rise after those levels. They have levels to drive first a con-

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siderable way at the lowest part of their working, and then that will be wet for the men to work on.

3775. If the men lay on their sides, the water drives under them into the levels?—There is no water after the levels get driven.

3776. Does not the water flow on the floor of the mine?—It does; but if they drive the levels at the lowest part the water comes out of the floors at the bottom, and drains all above them.

3777. But as they disengage the coal does not more water flow out?—Not when they get up to rise it does not, it comes out always at the lowest levels; the floor is very open, and the sulphur comes out there too.

3778. Do you know how many hours a man will work lying on his side in one of those seams?—They work eight or nine, or perhaps ten in some cases.

3779. Have they large wages?—No, I do not think they have; perhaps 3 *s.* 6 *d.* a day.

3780. You have never known less than 23 inches worked?—Not there; this cannel pit that has just been named is less.

3781. Do your men work on their sides there?—Yes.

3782. Do they work long hours?—They do.

3783. Is the mine dry?—It is.

3784. Are they well paid?—I think so.

3785. What will a hewer earn in the course of eight or nine hours?—Four shillings or 5 *s.*

3786. Do you employ any women down your pits?—Not one.

3787. Do you employ any females at bank?—I do not know of any except one; a banksman brings his daughter sometimes; he is getting into years, and she will come with his breakfast and assist him.

3788. But it is not the practice?—No; I set on two men from Wigan, and one brought his wife, and I would not let her go down.

3789. Is it the practice about Wigan to employ women in mines?—I understand so.

3790. And in most other parts of Lancashire?—Not about Oldham, nor Ashton, nor Duckingfield.

Veneris, 17° *die Julii*, 1835.

JOSEPH PEASE, ESQUIRE, IN THE CHAIR.

Mr. *George Stevenson*, called in; and further Examined.

Mr. *G. Stevenson.*
17 July 1835.

3791. IN the course of your former examination you were asked whether you had ever seen a copy of the printed rules issued by a relation of yours for the safe conducting of Pendleton colliery, to which you answered in the negative; have you since been able to procure a copy of that document?—I have it in my hand.

3792. Do you not think that similar precautions, printed and delivered to the workmen, having especial reference to the peculiar dangers of the miners respectively, might be very useful?—I think they would; extremely so.

[*The same was delivered in by the Witness, and is as follows:*]

Pendleton Colliery, January 2d, 1832.

RULES to be attended to by the OVERMEN at *Pendleton Colliery.*

First.—THE overmen are to go down the pit at four o'clock in the morning, to see what state the pit is in, and to set the workmen properly to work; that is for the first shift.—For the second shift at four o'clock in the afternoon, for the same purpose as above. The deputies for the first shift must go down the pit at ten o'clock in the morning, and must remain down until the last boy for that shift leaves the pit, which will be at seven at night. For the second shift, they must go down at ten at night, and remain until seven in the morning, when all the boys for that shift must leave the pit. The deputies must be chosen by the overmen, who will point out the work they are to attend to, as circumstances may require.

Thirdly.—The

Thirdly.—The overmen must make up their bills every fourteen days, or on the Wednesday before they are paid, which must contain an exact account, and number of curves sent to the shaft by each man, or set of men, which must tally with the banksman's account. The yard work to be measured and divided between the two shifts.

Fourthly.—The overmen's bills must be delivered to me on the Thursday morning previous to being paid, and not to be later than ten o'clock in the morning, so that I may have two clear days to examine them in. It must be further understood by the overmen, that the men they choose as their deputies must thoroughly understand plate-laying in all its branches; they must also have a general knowledge of colliery concerns, such as prop setting, examining the roof or cover, to forewarn the men and boys of approaching danger in the absence of the overmen. The water courses must be examined at least once a week. The stoppings must be frequently and closely examined, to see that there is no escape of atmosphere, which should go to the furthest extremities of the workings. Should the air or water course be in the least degree obstructed by stone falling, or any other casualties, the deputy must acquaint the overmen, and the overmen me, so that proper means may immediately be used to clear or widen the place so contracted.

Fifthly.—The air and water courses will have to be attended to by the overmen and deputies until the working has reached a certain distance from the shaft, when it will then require a man or two to attend to that alone. The brick stoppings must be built a certain distance from the main road, so as to insure their being erected in a sound part of the mine, to prevent the atmosphere making its escape through the rents or shaken parts of the coal, which generally takes place by the weight of the cover. If any rubbish should accidentally fall from the roof during the progress of the work, it may be laid up against the stoppings, until opportunity suits for taking it away. As these stoppings frequently require to be examined, they must not be hid for any length of time. No water whatever must be allowed to remain on the tramway; and small channels, or drains, must be made at every downbrow which will have to pass through under the stoppings; at the same time they must remain air tight, which I will explain to the overmen the simple method of doing it.

Sixthly.—The overmen and deputies must thoroughly understand what is generally termed trying the candle, in parts of the mine where it is expected inflammable gas may accumulate, to ascertain whether it is near the firing point or not; if in any degree dangerous, none must be allowed to go there without using the safety-lamp, and not the naked candle. The parts most likely to be charged with inflammable gas will be on the rise side of the workings, it being much lighter than the common atmosphere. It will require their greatest attention on the Monday mornings, or when the pit has not been worked for a few days.

The above remarks being strictly attended to, there can be little danger; but being neglected, there is no doubt, is the cause of many of the dreadful explosions that so frequently happen in large colliery districts, which too frequently has been the ruin of the enterprising coal owner, and, at the same time, awoke the wives and mothers of the sufferers from their slumbers with a dreadful crash, and at one blast bereaved them of all earthly comforts. I trust I have said quite sufficient to prove the necessity of having men that will work to the orders given by those who have to be responsible for the property of the capitalist and the lives of their fellow countrymen.

I had almost forgot to state, that as the air course extends in distance from the shaft, instead of being contracted as they frequently are, they should, according to the properties of gases, be increased in the area, which greatly decreases the friction, and allows the atmosphere to pass freely to the furthest extremities of the workings, for the purpose of sweeping away that devouring element hydrogen gas.

The above Rules are drawn up by

Robert Stevenson, Civil Engineer.

By order of *John Fitzgerald*, Esq. M. P.

Lunæ, 20° die Julii, 1835.

JOSEPH PEASE, ESQUIRE, IN THE CHAIR.

Richard Smith, Esq., called in; and further Examined.

R. Smith, Esq. 20 July 1835.

3793. SINCE your last examination the Committee have been informed that you have had considerable experience in the working of mines in other parts of the world besides Great Britain?—Yes, I have.

3794. Will you state in what parts of the world you have been so engaged?—In the first instance in Portugal; whilst I was there those I met with produced no gas. I am speaking now of coal mines entirely. I have been extensively engaged in copper and lead mines, but that is a different kind of mining altogether.

3795. In what province in Portugal?—The bituminous coal was at Fegara.

3796. Are there seams there a considerable depth from the surface?—They dip very rapidly; one in particular is at 45 degrees; and they crop to the surface.

3797. Are they worked from what is called the crop?—Yes; first by driving the way-gates down bank, and then striking the boards or galleries out on the level cross of the coal.

3798. You have stated there was no gas; was that the fact, or was it that the gas escaped so regularly in the process of working, that you found no inconvenience?—I believe there was no gas escaped from the coal; one was a bituminous coal, and the other anthracite, commonly called in England blind coal.

3799. What other countries have you visited besides?—British North America.

3800. At what part were those mines?—At Nova Scotia and Cape Breton.

3801. Were they at a considerable depth from the surface?—Nova Scotia mines appear to dip at the rate of about one in three and a half, and they crop to the surface as they do in England.

3802. Is there a great accumulation of gas in those mines?—In the mines of Nova Scotia; I never saw more anywhere.

3803. What means were you in the habit of adopting for ventilating those mines?—When we first struck the coal at a depth of about 180 feet, it was highly charged with water; the water flew out in all directions with considerable violence; it produced a kind of mineral fermentation immediately. The outburst of the coal crossed the large river, which passed near thecoal pit. We were not exactly aware of the precise out-crop, on account of a strong clay paste eight or ten yards thick. It is rather difficult to find the outburst of coal when clay paste is thickly spread over a country. At the river the water boiled similarly to that of a steam-engine boiler, with the same kind of rapidity; so that in putting flame to it on a calm day, it would spread over the river like what is commonly termed setting the Thames on fire; it often reminded me of the saying. It is very common for the females, the workmen's wives and daughters, to go down to the river with the washing they have to perform for their families. After digging a hole in the side of the river about 10 or 12 inches deep, they would fill it with pebble stones, and then put a candle to it; by this means they had plenty of boiling water, without further trouble or the expense of fuel. It would burn for weeks or months unless put out. I mention this to show how highly charged the coal was with gas. What I am now going to describe may be worth a little attention. There was no extraordinary boiling of the water, or rising of the gas, before we cut the coal at the bottom of the pit, more than is usually discernible in a common pond of stagnant water, when a long stick is forced into the mud. As soon as the coal was struck, at the depth of 180 feet, it appeared to throw the whole coal mine into a regular state of mineral fermentation. The gas roared as the miner struck the coal with his pick; it would often go off like the report of a pistol, and at times I have seen it burst pieces of coal off the solid wall; so that it could not be a very lightly charged mine under such circumstances. The noise which the gas and water made in issuing from the coal was like a hundred thousand snakes hissing at each other. It was very alarming

alarming at first, and I had to go every morning with the men, in the first instance, as I would not ask them to go where I would not go myself.

3804. At what date were you in Nova Scotia?—I was there very nearly seven years from first to last, but the first of my going was in the year 1827, and I returned and landed in England on the 4th of June last year.

3805. How were you about to work those mines, considering the quantity of gas, and its very inflammable quality?—In the first place I had two pits sunk; one I called the engine pit, for lifting up water, for drainage; the other was intended for the drawing or raising of coal. I united the pits with a headway at the bottom, and caused a hogshead in the first instance to be placed nearly at the top of the engine pit, with a great number of holes bored at the bottom of it. I then turned the water lifted by the engine into this hogshead; it run out again as it were from a cullender in all directions about the shaft, and thus created a regular water blast; the air descended the engine-shaft with the water, and returned rapidly up the upcast shaft. Having sunk to the bottom of the coal, my object was to drive a waygate in a right line to the outbreak of the coal in the crop; to ventilate it I cut an air-course or trumpeting in the side of the waygate, in the solid coal, about two feet high, and about two feet wide, and built the front up with bricks and mortar very tightly indeed; in this way, [*describing it on paper*] that is the roof; that [*pointing to the paper*] is the solid side of the coal. The fresh air went up the trumpeting, and formed a current over the men; it blew on them, and mixed up with the gas, so as to dilute it sufficiently to prevent its being explosive. At the outburst I sunk a little shaft eight or ten yards deep, that completed my ventilation; after that I began to drive out the boards, which are now some miles in extent.

3806. Is there any other opportunity for gas to escape, than through the drift at an angle with the level crop?—There is an arrangement of boards at the level cross of the coal. I left 25 or 27 boards, six yards wide each, and the ribs of coal three yards. I got the coal out at once, not leaving it to work over again, but in the first instance some of the ribs were three yards thick, some two yards and a half, sometimes two yards, according to the weight of superincumbent strata which they had to bear. As we progressed, I sunk pits in the crop, in a line with the face of the work, which carried off the admixture of gas and air, after it had passed the workmen. By that means I succeeded in maintaining a pure and wholesome ventilation. As the coal became drained of the water (it was exceedingly wet at first), the gas was drained also, and when I left it there was very little indeed, compared with the issue in the first instance; and the little there was, was chiefly in the wet boards where the water continued to bleed; the air ceased to rise in the river as the coal was drained of the mine water. I merely mention this to show that I believe stagnant water has very much to do with the generation of gas in the first instance, and that coal mines, by not being pressed too heavily, are capable of being drained of the gas very much indeed.

3807. What do you mean by the term pressed too heavily?—Worked too rapidly before there is time for the natural exhaustion of the gas. Give the coal a little time to drain itself of the water, and it generally happens that the gas in the crop becomes weaker also. There are other kinds of coal with no gas at all.

3808. In the same field?—In the same district, and particularly in the Isle of Cape Breton, which is an adjoining island. I also noticed, and made it a matter of attention, that where the gas was, the superincumbent strata was a kind of bituminous schist; where there was no gas the free-stone rocks prevailed, and formed the roof of the coal or were only separated by a thin bed of clay or soft clunch. The gaseous coal mines which I have named may be ventilated on the same principle to any depth, unless they are cut off by some dykes or uplifts; they go to the depth of 800 or 1,000 yards. I have no doubt but that the mines to that depth may, on that principle, be successfully ventilated, and safely so to the workmen. I have not the least doubt about it. I speak now as a professional man.

3809. Do you propose to illustrate the fact of which you have spoken, of the excessive generation of gas by the absorption of water in the coal, upon strictly chemical principle?—I think stagnant water has more to do with it than otherwise. I do not mean to say that water passing through the coal, what we call the lipes, or open spaces of the coal, has so much to do with it as that which is forced by its own gravity or weight into the very grain or fibrous parts of the coal, something like sap in a tree. But I speak more from what I noticed to be the case;

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I was struck with it; it was highly charged with stagnant water, and as that drained off, the gas disappeared in nearly the same proportion.

3810. Did you ever take any minute observation as to whether the coal wrought in the early part of your workings, when the generation of gas and the effusion of moisture was great as compared with the way in which it burnt, and afterwards when that absorption of water had not taken place, or that quantity of gas been expelled, as to the burning of the coal?—I was particular in noticing that; I found no difference.

3811. You are aware that everybody is anxious to have coals for his own consumption immediately on being drawn from the colliery?—Yes.

3812. You are aware that it is a fact that coals at the pit's mouth burn a great deal more freely, and the combustion is much better than after they have had a sea voyage, as is the case with coals brought from the north of England to this metropolis?—Yes; I presume there is a great deal in that; but that is as much from the moisture of the coal as from anything else. If all coal were to be dried in ovens, it would exhaust much the bitumen which it contains; it does not burn so freely and powerfully unless there is a bulk of it. One single coal will not burn at all; put two together and they assist each other; they reflect their own heat and give it out to each other; but if these coals are perfectly dry, I believe they will not burn so well. If coal for domestic use is put partly into a damp cellar, and partly into a dry cellar, it will burn very differently in the same house, so that I do not think it altogether relates to the gas having escaped from it; I think the bitumen of the coal is better preserved by water or dampness. As to the nature of the fire, and whether it produces more dust or less dust, I think it depends on the quality of the coal, whether it possesses much pyrites, or is free from it; that which possesses a portion of iron pyrites has a brown dust, and is rather heavier; that which is perfectly free from it approaches more to the nature of charcoal, and has a white dust. Hence the reason, perhaps, why Staffordshire coal, or all such coal is more objectionable for the London fires than the Newcastle coal, which coal gives no better heat than the Staffordshire. The objection mainly is, the dust; it is not so liable to pyrites; it is a sweeter coal in the burning, and is not so subject to sulphur.

3813. Now, with regard to the per-centage of carburetted hydrogen that you have obtained from coal, have you ever experimented on this subject, taking coals immediately drawn from the colliery, and those that have been exposed for a considerable length of time in barges or otherways, as to the number of cubic feet of gas, per ton or per hundred-weight, which might be obtained from coal under those relative circumstances?—I have not; but I have understood that some vessels have taken fire after the coal has been put into their holds, and I have been informed that has arisen from the gas which has escaped from the coal. I think there may be some mistake about that, for very small coal put into the hold of a vessel is apt to become hot, like a hot-bed; the heat arising from itself may create gas that might fill the hold of a vessel, and consequently explode when exposed to flame; whereas, if the same coal had not been so closely confined as it is in the hold of a vessel, the gas alluded to may not have escaped at all. Small coal, when heaped together in large quantities, undergoes a fermentation, at which time it imparts more or less gas.

3814. You are perfectly aware, that in the north, some of the coal, the refuse, or small coal, will ignite spontaneously if lying in heaps for 14 or 21 days on the surface?—Yes; and some sorts of coal in America will do the same if laid in heaps, where there is not much large coal mixed with it, it will very soon ignite from spontaneous combustion; but this is coal that is more or less charged with pyrites.

3815. Did it ever strike you, in Nova Scotia, how far it would be desirable to introduce the safety-lamp into those mines?—We had it with us.

3816. In regular use?—It is always used to the present hour every morning by the overman going through all the boards to examine them before the workmen go in, and, although that is the case, there is not so much necessity as propriety in the measure. The ventilating system has had no alteration from the discovery of the safety-lamp, although I never advise any colliery to be without it, whether much accustomed to gas or not, or even if none has ever been seen. Gas has appeared in approaching a great dyke, where none was ever observed before; such places ought always to be proved by a safety-lamp.

3817. The position of some of the coals of which you have just spoken was very

very peculiar; but how would you proceed to ventilate a mine in such a state, provided the inclination of the dip and the rise had not been but 1 in 12 to the horizon?—Some of the mines in America are 1 in 12, and 1 in 9 and 7. I should have proceeded to the mode of exciting ventilation.

3818. Do you think you could have dared to introduce a furnace?—I should not have passed the air so highly charged with gas through the furnace in the first instance, there was so very much gas in the coal when we struck it, it would have been dangerous to have resorted to such an expedient; I did it by forcing a great quantity of air down; I had no other means; we were left to our own resources, and if we failed in them, we failed entirely, for there was no assistance there.

3819. What was the thickness of the seam?—Nearly 40 feet; the lower part of it was not so good; our operations were confined to about 10 feet.

3820. How many acres would you have proposed to have won with one pair of shafts, supposing the dip to have been at the moderate rate alluded to in a former question?—I think I should not have excavated with one pair of shafts more than 12 or 14 acres; but if I found the mine drawn of its gas, I should have extended in proportion to its reduction.

3821. Notwithstanding the limited extent to which you would have worked, you would still have thought it expedient, if not necessary, to have had a safety-lamp as an instrument daily in use?—Yes, merely to try the work; for instance, suppose there was any check to the ventilation by the falling in of the roof in any part, so as to injure or break down any of the doors or stoppings, and thereby derange the ventilation in the course of the night, I should think it always advisable that the overmen should go through the work the first thing every morning, to try with the safety-lamp the state of the air, before the men were allowed to go with their naked candles or common lamps.

3822. Then, upon the whole, these seams of Nova Scotia may be considered as resembling much more closely the seams met with in Staffordshire than those in the north of England?—The one I am alluding to might be so as far as 10 feet, but no further; all the other seams are about the same thickness as those in other parts of this country, some 5 ft., some 3 ft., some as high as 6 ft.; I have seen them 7 ft.

3823. Is the rise and fall of stratification similar in the thinner seams?—It is not so rapid generally; in Cape Breton the greatest rise is one in seven, and so on to one in 12 and 15, which is very easy; but those in Nova Scotia are one in three and a half generally.

3824. Have you visited any other parts of the world where there are coal mines?—I have been to the United States, but never went to the coal mines; they have no bituminous coal between the Gulf of Florida and Nova Scotia to the east of the Allegany Mountains, it is chiefly anthracite; they are very deficient of bituminous coal in the United States to the east of those mountains.

3825. Are you of opinion that in case the Government of this country should issue a commission composed of scientific men, as chemists, geologists, or mechanics, that any obstruction would be thrown in their way by the proprietors of coal mines in making a practical examination of their mines?—I should think not; on the contrary, it certainly ought to be courted. If it were known among the workmen that that commission was instituted for their safety, I think no prudent man would set his face against it.

3826. Would you, as a professional man, very extensively engaged in mining operations, approve of the appointment of such a commission?—Most highly; and I think nothing is wanted in this great mining country more than that is. I hope another year will not elapse without its taking place. The mines now give the great return of the kingdom; it is a mineral country from one end to the other.

3827. Are you of opinion that the commercial interests of this country, as well as the ends of science and humanity, would be served by such an investigation?—I think they would most materially; miners or colliers are beset with dangers on every side the moment they get below the sod, or the surface of the earth, even the moment they take the rope, for we hear of ropes breaking with them; they are beset with dangers on every side, and humanity calls upon us to reduce those dangers in every possible way; it is our duty to do so as far as lies in our power, and I believe much may yet be done in that respect.

3828. Are you of opinion that the results that followed the voluntary visit of

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Sir Humphrey Davy to the colliery holds out encouragement to further investigation, such as has been alluded to?—Yes, I think it does; but here I must remark, that I never heard till I came into this room that Sir Humphrey Davy had declared, or made it known, that with his lamp the miner was liable to explosion under particular circumstances. I knew that it required to be kept clean and in good repair, but I was very much surprised indeed to hear, in evidence given in this room, that Sir Humphrey Davy himself had declared it unsafe under any circumstances, and I am very confident that communication has not sufficiently been made public. I think if it had been so I should have heard of it somewhere. I have been very much amongst mines, and I never heard it until Mr. Buddle stated it in this room.

3829. Are you aware that it is on the minutes of this Committee that he performed the experiment before the Earl of Durham, Mr. Buddle, and other individuals, to demonstrate the possibility of such an accident and explosion?—I heard Mr. Buddle say so; that was the first time I ever heard of it in my life; I believe the information is very much confined to that part of the world or I must have heard of it.

3830. Then have you apprehended that, until very recently, it has been the settled conviction of the working miner, as well as those immediately above him, that the lamp was free from any risk of explosion under any circumstances whatever?—I believe there are thousands of men whose lives are always on the palm of their overmen's hands, who know nothing to the contrary at this moment, or that if they did they would not venture into the dangers to which they are exposed; that I believe.

3831. And in consequence of that they have no idea of the risks they run in encountering currents, or in the sudden removal of their lamps?—Yes. Hence the propriety of distributing a kind of tract among workmen in different parts of the kingdom with useful suggestions and cautions as to dangers, and how to restore life under circumstances of suffocation from carbonic acid gas, and as to improvements in the safety-lamp, and how to discriminate between a lamp that is safe and one that is not, and the necessity of keeping the lamps clean, and of their undergoing a proper examination either daily or periodically. I think such a measure would have a very good effect.

3832. Were you present when Mr. Litchen, from a coal district in Staffordshire, was examined?—Yes, at the commencement of his examination.

3833. Are you aware that he stated the fact of a mine exploding at the lamp, in consequence of a sudden fall of water in the pit?—Yes, I was in at the time; I never heard of that before. I think that was in the early part of his examination; indeed it must have been, for I did not hear the whole; I was called out.

3834. How do you account for it that such a startling incident did not become known to you, residing at such a short distance?—I must have been out of the country at the time. I have been absent nearly seven years. I first went abroad in 1826; I was then in Portugal. In 1827 I went to British North America and the United States, and returned on the 4th of June 1834, and in all probability that accident took place in my absence. That may also account for my not having heard of the accident alluded to in my former examination, which the Committee said had taken place in Staffordshire.

3835. Have you known accidents arising from the use of the lamp?—Not that it could ever be brought home to the lamp. I generally treated the lamp with a great deal of confidence myself. I was aware that if there was any danger in the lamp, it must be incurred where it was moved suddenly, to give a great bias to the flame.

3836. Do not you think that the general body of the colliers are aware of that fact?—No, I think not; how they may be in the neighbourhood of Newcastle and Northumberland I cannot say, as I never was there; but in the collieries in the midland counties, and where I have been, I never heard the circumstance alluded to by any one, and that was one reason for the care I took in my former evidence, when speaking of the danger or difficulty of using the lamp as a mining implement, to give light in holing under the coal. It is necessary to keep the lamp on its perpendicular; if it is laid down, the bias of the flame comes in contact with the wire; therefore the lamp is not so useful to the miners in underworking some of the thin coal. In some cases it is underholed four feet; the men lie down, and their heads and shoulders are confined to a space about 14 to 16 inches high; it terminates

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terminates in a mere groove at the back part of the holing, and unless the light can be effectually thrown there, the men cannot work to proper advantage.

3837. That is a kind of investigation he makes to find if there are any fissures or cracks that will facilitate his bringing down his coal?—No, it is to throw a weight of coal to separate itself from the roof; the more weight the miner can throw on it by underholing, the easier it comes down; that avoids the use of gunpowder.

3838. Is he not also on the look-out for a natural back or division in the coal, at which he might easily bring it down?—No; the natural back is what we call the reed, the split, the cleavage of the coal, which is continually at the pike point. You may cleave wood to three-fourths, one-eighth, or the sixteenth of an inch, if you take the right grain; that is the way coal is worked; if we did not attend to that we could not work it to the same advantage; take it one way it will split easily, take it the other, and it is obstinate and difficult to work. It is much like a piece of timber, which will plane easily the right way of the grain, but not so across the end.

3839. Are you not aware of what are called by miners air-backs, which travel through the coal perpendicularly?—I think there must be some mistake in the evidence I have heard here upon that point; some persons call a back what by others is called a lipe or opening, where the coal does not join; others call a back the reed of the coal, the cleavage of the coal, or the split of it; and that mistake might easily be made, so that the answer might appear to contradict the question. I wish it to be understood that the cleavage of the coal is what we always aim to work upon. If a man is working on the face of the coal, the more weight he can throw on the block of coal he is underworking, the easier it will split off by that weight from the back or solid wall, and in most parts of the kingdom they like to avoid the use of gunpowder. If the use of gunpowder could be dispensed with in the north of England, the coal would be much more valuable when it comes to market. The great shock it receives from a blast of gunpowder, occasions thousands of dislocations that the eye cannot easily discern; but when it is afterwards exposed to wet and dry, and particularly to frost, and becomes tossed about in moving from place to place, the fractures thus made easily give way, and the coal crumbles into dirt, much more so than if it never received that shock; therefore, in Staffordshire and the midland counties they try to get the coal by wedges as much as possible; it creates more labour, and perhaps a little more expense, but the proprietors gain by it in the better quality afterwards.

3840. What quantity of coal is obtained from the mines in Nova Scotia?—When I left it, about 42,000 chaldrons a-year.

3841. Are they worked to profit?—They ought now to be. My object in going was to start the mines; they are able to raise from 80,000 to 100,000 chaldrons; the difficulty there is in finding a market.

3842. Do you think they are likely to supply themselves and export?—In Nova Scotia they can do that now; their own consumption internally is limited, on account of the great abundance of wood, which the people burn. The consumption of coal is in the manufactories and steam-boats, and such like establishments, which they now carry to a very great extent in the United States; they have no bituminous coal of their own between the Gulf of Florida and Nova Scotia, to the east of the Allegany Mountains, that will work a steam-boat at sea, which is a distance of nearly 3,000 miles; that is very important to this country.

3843. What is the price at the pit?—Do you allude to currency or sterling?

3844. Sterling.—I will just state to you what it is in currency. It was 21 *s.* in Cape Breton, and 18 *s.* in Nova Scotia, but the company have reduced the price in Cape Breton to about 16 *s.* or 17 *s.*, and in Nova Scotia to 14 *s.* 6 *d.*, put on board, into the hold of the vessel; this is currency. Now an English shilling is there worth 1 *s.* 3 *d.*, so that is a matter of calculation; you take off a tenth and whatever may be the rate of premium.

3845. Is a considerable quantity taken to New York?—There is, and I think it is likely to be in great demand.

3846. Is the chaldron the London chaldron?—Not exactly. The Nova Scotia chaldron is about half the Newcastle, that is, what the London is; but they are not quite so particular there, consequently the measure is rather more.

3847. Is it not the case that the export to the United States has been considerably checked by the north country coal; English coal being carried out in ballast?—It is in some respects; but that will always be limited; that must be

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confined to the intercourse between the two countries; it will only influence the free port markets.

3848. But the export to the United States of the Nova Scotia coal has been checked, and the English coal is underselling the Nova Scotia in the markets?—That will be always limited to New York and Boston; not to the great intermediate places where the manufactories are. If a vessel is consigned to New York, it has to be discharged there, which makes a second voyage if the coal has to go into other parts of America; for instance, up the shallow rivers. The American coasting vessels which are made for shallow rivers, for the purpose of carrying wood, will make a voyage to Nova Scotia, and will take the coal to the place of consumption on such rivers without a second voyage, and thus compete with the English coal successfully. I was going to remark, that when coal is blasted with gunpowder, the dangers to the miners are rather increased; for instance, the gunpowder is generally inserted near the roof at the top, for the purpose of bringing down the block of coal after it is under-worked, and the shock has a tendency to disturb the roof, so that when the coal is carried away, the miners are compelled to be a little more careful in examining the roof that it does not come down without giving the usual notice after the shock of the gunpowder. Whereas when no gunpowder is used, the roof generally gives notice, which I explained in my former evidence.

3849. Have you ever known an accident to arise from the use of gunpowder?—Great numbers of men have lost their lives, others their sight, legs, fingers, and arms, and have been otherwise greatly mutilated. Great numbers indeed; but that applies to all descriptions of mines, as well as coal mines, to lead mines, copper mines, zinc, &c.; without the use of gunpowder they could not be worked.

3850. You said in your former examination, that you were not acquainted with the collieries in the north of England?—I never have been there.

3851. You were present when Mr. Buddle and others were examined?—I was present at two days' examination of Mr. Buddle, and at some trifling examinations afterwards; not his first day.

3852. Did anything occur to you as a practical man in hearing those examinations, with respect to the danger so imminently incurred by the miners of that district?—There did. It must be what occurred to me on hearing the examinations, for I have never been into that district; it did appear to me when I saw the plan which Mr. Buddle exhibited, that their works were carried to an extent beyond the safety of ventilation, considering the high per-centage of gas they were represented to produce. I have no wish whatever to interfere with other people's concerns, except so far as relates to the safety of the miners, and if I saw anything wrong in that respect, I think I should not discharge my duty and my conscience unless I tried to remove it.

3853. By additional shafts?—There are various ways to determine it.

3854. You said in the very dangerous works you superintended in North America, you relied entirely on ventilation?—Yes, always, wherever I went; I think I should not be doing justice to the miners under my care, if I left them entirely exposed to the use of an implement, which itself being liable to accident, might destroy the whole of them. If there had been such an explosion in the coal mine in Nova Scotia as there was in the north of England the other day, it would have swept away the entire establishment of that company.

3855. Your impression was, that if you had pursued those mines to an extent beyond the means of ventilating them properly, imminent danger would have followed?—The greatest danger, by avoiding the necessary expense to the proprietors. Besides, coal mines wrought by the use of gunpowder ought to be well ventilated.

3856. Did it appear to you, hearing the examination of the gentlemen from the north, that the mines were there worked so rapidly and so extensively as to proceed beyond the means of affording them sufficient means of ventilation?—When I saw the plan produced by Mr. Buddle, but which I had not an opportunity of examining carefully, nor except when under examination by different gentlemen, I was surprised to see the extent at which those mines were opened, compared with the limited means of ventilation in the shafts.

3857. You think that that may account in some degree for the tremendous accidents that so frequently occur in the north of England?—I am afraid the working of mines is carried beyond its proper bearing in some parts of the kingdom; and to do that, ventilation is often overstrained. In consequence of what

I did

I did hear, I have made this statement; and being a professional man, I am as much exposed as other engineers to accidents, and so are the workmen under my care as well as myself; thus it is necessary I ought to be careful how I state anything regarding other people.

3858. You are aware that the mines in the north are worked sometimes 25 miles with only one or two shafts?—I never turned my attention to mining in the north so much as since I have been here, and I now understand that what you call 25 miles, is not a distance of 25 miles in a direct line from the shaft, only of air-coursing, perhaps extending over some 200 or 300 acres. I am quite aware that is the case, from which cause I believe some accidents have arisen.

3859. In proportioning the number of shafts, of upcast and downcast shafts, which do you think the safer plan, to have a greater number of downcast or upcast shafts?—I will give you my opinion on that. The downcast shaft takes in the atmospheric air in the state it happens to be, according to the temperature of the day. If it is in the colder seasons of the year, it goes down more condensed; if in the warmer season, it descends in a more rarified state. If in the cold season, the greater the rarefaction when below ground, consequently, the greater the expansion; therefore, unless a larger aperture is employed to take it out, than to admit it into the mines, the return current must be increased in speed in proportion to the expansion, with the addition also of the gas generated. When the air has been under ground a certain number of hours, and becomes charged with gas, to a certain degree it ought to undergo a test; that test might be easily made, as there is always inflammable gas in the mines in a pure state. Suppose at the end of 300 yards out of the 25 miles, or at the end of a mile, a place is fixed on as a station where the air should be tested; take a bottle full of water and let it be held in the current, the water to go out; it fills with the run of the current, then close it with a cork, take that bottle to a room appointed for the purpose, and you will find, by adding pure gas, the real state of that atmosphere at the appointed station. Go to another situation farther on, or take a number of bottles filled with water, and thus prove the state of the air at as many stations as you please; by this mode you will easily ascertain the quantity of gas absorbed by the atmospheric current between the different stations, till you find out the point where the air becomes dangerous; and after that the manager ought to be very cautious about the workmen being exposed to that current. There I think some useful improvement might be suggested, or perhaps there might be other more simple means of testing it; but that is a very simple process.

3860. Does not the elongation of the flame and the quantity indicate the danger?—It gives a sort of notice, which is the only notice the miner has. The flame elongates when approximating to the firing point.

3861. You said that there might be other means of improvement of ventilation, besides that of increasing of the shafts?—I said there might be a variety of ways, but much depends on the position of the coal. If it was a flat mine, the ventilation might be more or less artificial. Suppose in a hot summer's day, a sultry day, the air is warmer above ground than it is below ground, though it has got the natural warmth of the earth, assisted by the horses and men to make it so, yet it is warmer above. The consequence is, that the air above and that below strive against each other, and the ventilation is checked, and difficult to maintain. Thus the air passes too sluggishly through its course, and remains too long in the earth. I consider it would be 15 days passing through an extent of mining excavation named to me by one of the Honourable Members of the Committee, though I say it ought not to be under ground anything like that time.

3862. By what contrivance would you accelerate the current of the air?—There are three considerations; the first is, to decide what is an explosive mixture. I believe Sir Humphrey Davy has laid down a rule. He says that 14 parts of atmospheric air, and one part of gas, form an explosive mixture. That being decided, the next question is, what ought to be the speed of the current of air, so as to make it safe and comfortable for the workmen employed in the mines. Now I am coming to the point alluded to. The current must be governed by the safety-lamp, and as the safety-lamp will explode if the current much exceeds three feet a second, it certainly would be attended with danger after that. Besides, it would be too powerful for the workmen's candles, and render them useless. The standard of the current, therefore, should not exceed three feet per second as a maximum speed; it ought to be rather less to make it safe. Thus we have arrived at the maximum of mixture of common atmospheric air and

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hydrogen gas, and at the maximum of the speed of the current. Now we come to the quantity or extent of excavation to which all mines subject to gas ought to be allowed to go.

3863. By what contrivance is the current of air accelerated? If to improve the ventilation, by what contrivance, except by the increase of shafts, can you produce a supply of pure atmospheric air, and accelerate the current of air so introduced?—We can put any quantity of air into mines we please, by mechanical power. A blast furnace is supplied by a blast engine of great power, and the air rushes in with a current that makes a roaring noise; but we cannot work the mines in the same way; it would blow out all the lamps and candles; there must be a regulation at which we must stop, and we must not exceed that regulation, if we do, we interfere with the workmen and their lights. Then it comes to this, that if we are to confine ourselves to a current, we must confine ourselves to a space to be got by each pit, according to the quantity of gas which the coal produces. That space I have before laid down in a kind of table, which limits mines at work where gas is produced, at the rate of 20 per cent. of its own space; in 24 hours it would limit it to 13 acres.

3864. The coal field must be worked at so many separate winnings?—Yes; unless the coal becomes exhausted of its gas as the work proceeds.

3865. By what other mechanical means?—I think Mr. Martin showed me a plan since I have been attending this inquiry that he was preparing; I really think that is about the best I have seen; it is accomplished by enclosing the top of the pit with a kind of house, and introducing a series of fans to work by machinery. I think that would have the effect, without the risk of furnaces.

3866. Was there any loss of life from explosion in Nova Scotia collieries while you were there?—Not while I was there; but before I went there was a person from the north of England that worked those mines above the level of the sea, and he had two or three explosions, and lost several lives there, even when his pits were not deeper to sink than from seven to 14 fathoms. I was very much surprised at it. However, all our workings were below the level of the sea, and the tide came up to the pit within about 150 yards at high water. The top of the shaft was not more than six yards above high-water mark. We never lost a man by explosion.

Goldsworthy Gurney, Esq., called in; and further Examined.

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3867. UPON a former occasion you requested the liberty to reserve to yourself the opportunity of being further examined, with the approbation of the Committee, more particularly as regarded the ventilation of mines; have you considered the subject as to that?—The subject of ventilation is one which I have considered, with a view of effecting without the necessity of having fire in a coal mine, in pursuance of my former proposition. All scientific and practical men agree, that where there is a free ventilation, and "fire-damp" is sufficiently adulterated, there will be perfect safety from explosion. This end is one of the most important consequence on other accounts: ventilation is now produced by rarefying of air by fire in the upcast shaft. This process of ventilation, from the nature of its action, must be limited as to the quantity of air it can displace in a given time, and in case of extra disengagement, gas may accumulate in such quantities as to saturate the air to the explosive point; so that this fire itself may explode the mine. The plan I suggested of lighting coal mines by reflecting highly concentrated light, I feel assured will at some future time be employed; notwithstanding, I conceive practical men will for a time anticipate great difficulties: certainly, until they are fully acquainted with the nature and peculiar qualities of the new light proposed to be used. But if it be found practicable hereafter to apply reflected light to light the galleries of mines, it will be a great object to remove the fire now used to produce ventilation. Under these circumstances, and in this anticipation, I am desirous now to suggest the possibility of ventilation by means of high-pressure steam; a principle that has lately brought about such considerable and important results. There is no difficulty in producing an unlimited current of air by means of high-pressure steam, through even a contracted upshaft, where such is unfortunately found inefficient under the present limited method: a bushel of coals will raise sufficient steam, if applied under a certain simple arrangement, so as to displace upwards of 350,000 cubic feet of air. Consequently if a larger quantity of steam be employed, a larger quantity of air may be displaced, and thus the largest mine may be fully ventilated, and filled with fresh atmospheric air in time proportioned

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to the emergency, at will; so that the galleries may be brought to such a state of adulteration that the contents of the mine will not be explosive. Perhaps the Committee are aware of the effect of a jet of high-pressure steam made to pass through a chimney or a shaft; if not, I beg to state, that it occasions a most extraordinary and powerful draught, incredible to those who have not seen it. Ventilation by it may be carried to an extent that never has been possible to be equalled by rarefaction, the air-pump, centrifugal fan, water draught, or other mechanical means. We may employ this means and obtain a draught of any quantity or intensity at pleasure. The same effect would be produced either in an upshaft or down. I think if the current, instead of being made in the upcast shaft, were made in the down, it would be still better in practice. We know, wherever a partial vacuum is produced, air will run by the shortest and nearest passage to it. From the downcast shaft, therefore, air will go through those galleries only which are most direct, whenever a draught is made, no matter by what means, in the upcast shaft. But if air be in *plus*, it will percolate through every gallery. The laws of aeriform and other fluids are the same; we know, if we draw water through a tube connected with a series, it will run through one or two and not through the rest; but if it is pressed, it will strain through the whole: the blood, for instance, from the heart is pressed through every anastomosing vessel; this would not be the case if drawn through. So in mines, if a strong current of air be driven down instead of being drawn up, we shall have a greater chance of ventilating throughout the whole mine. If found desirable, both the up and downcast principle may be used at the same time; there may be a strong current made in the upcast, and a strong current at the same time made in the downcast, so that we shall have a double power acting, one in depressing the other in raising the quantity of air out of the galleries. In this case perhaps air-doors might be partially necessary. This method of ventilation would not interfere nor be affected by change of temperature or any state of weight of the atmosphere.

The recesses of mines, the blind shafts or *cul de sacs*, are and will necessarily be out of the influence of the current, and fire-damp will always accumulate in those parts of the workings without some means of removing it; it is in those parts that the gas mostly escapes. It becomes a very desirable object to be able to ventilate the recesses of mines as well as the general gallery, and for this purpose the same principle of local ventilation may be used; instead of carrying the steam to them, which would be inconvenient, compressed air may be employed, and allowed to escape so as to produce a sufficient draught into the *cul de sacs* as to effect a complete ventilation, or inexplosive mixture with the gas. A very small quantity of compressed air will last a long time in effecting a good draught or current. One square foot will displace several thousands used under this principle. In reference to my former evidence I beg to observe, that in case a mine is perfectly ventilated in the galleries, which I conceive possible to be done by this means, and the recesses should not be so, that these recesses of the mines only would be dangerous; and in that case there would be no objection in using the principle of reflected light to light these recesses. As the great galleries would be safe from explosion, the lamps and parabolas might be fixed in them, and the light reflected into those workings; and, as a further security, they might be surrounded by wire gauze, or protected by insulation. I conceive that a stationary lamp, or series of lamps, may be supplied with air, to support its combustion, by a tube passing to them from out of the mine; and that the unconsumed air and carbonic acid might be carried away from them by a second similar tube; thus completely insulating the lamps from the atmosphere of the mine, and be the most perfect safety-lamps possible to be adopted.

3868. Will you give the Committee a concise familiar description of the apparatus you would employ in the use of high-pressure steam?—A common boiler, furnished with a small tube leading to the shaft, and pointing either up or down as you desire the current to be driven, placed in a cylinder, the size of which must be governed by the quantity of steam used, or the quantity of current you intend to make. A very small jet of steam, at 60 lbs. to the inch, of about the size of a goose quill, will dislodge 350,000 cubic feet of air in an hour. Though difficult to detail without drawings or model, it is known to several scientific engineers, and there is no difficulty in getting it made. I shall be happy to show it in action to the Committee, or any one interested in the subject.

3869. Can you conceive the effect that would be produced on the workmen situated one mile from the point of explosion with the increased quantity of air?—It could

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could make no difference in such case; but if the increased current is sufficient, there could be no explosion in the galleries.

3870. But of the steam?—There could possibly be no explosion whatever of steam.

3871. How do you propose to prevent that?—There is no boiler used in the mine. Unless you were to see it in action, I do not think I could make it intelligible, and therefore will not take up your time by attempting it. The quantity of steam which goes into the mine is very little, scarcely worth notice, and is all dissolved in the extra air which it compels to pass with it: there is no visible steam; the air will be very little charged, so little as not to be detected by a delicate hydrometer; if used in the upcast shaft, it would escape in the atmosphere; it is only in the downcast shaft that a small portion of steam would go down; but if such should be an objection, you might use compressed air instead, precisely on the same principle. In this case you must use machinery for compressing, which had better be avoided in all cases wherever it can. Steam may at once be taken from the boiler; it is most effective in this way; and any inconvenience from the steam itself I conceive could not be felt. I think it possible under this mode of ventilation to do away with the air-doors; I think a sufficient quantity of air would pass down and through the whole of the galleries of a mine so as to dilute to the inexplosive point. A mine of 10 miles might have the whole of the air contained in it, taking the galleries to be five feet square on an average, driven out and filled with fresh air every 15 minutes, let the area of the shafts be the smallest now sunk, such is the singular power of the steam draught.

3872. You say the doors may be often used to regulate the quantity, or to diminish it?—Yes, if such be necessary; also, to compel draughts into certain galleries, if required.

George Birkbeck, Esq., M. D., called in; and Examined.

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3873. YOU are a member of most of the learned bodies of the metropolis?—Of several, certainly.

3874. In your long professional career, you have made scientific subjects the great object of your attention?—A very great object.

3875. You are aware of the nature and object of the inquiry upon which the Committee are at present engaged?—I am.

3876. And that the inquiry has divided itself very much under two heads; the one the proper ventilation of mines, the other the application of such instruments as might reduce the real or supposed danger arising from imperfect ventilation?—I am aware of that useful division.

3877. Have you ever considered the subject of the ventilation of our coal mines of Great Britain?—Only in reference to the performance of ventilation generally, as to rooms of every description, mines being ventilated, if they are ventilated at all, on the same principles, with certain great additional difficulties, arising from the length of space to be ventilated (amounting in all its convolutions sometimes to 31 miles), still always requiring the same process, that is to say, allowing heavier air to displace air that has been rendered lighter by some means or other, and thus in short producing motion in the shafts.

3878. Or by the application of mechanical pressure?—Which is one mode of producing motion in the air of mines and shafts, and the best mode, if you can afford so to produce it.

3879. As you are doubtless familiar with the use of the air furnaces and other means which are generally adopted, has anything occurred to you in considering the subject by which the object to be attained may be more readily and more completely attained?—It has not; for it has always been a question with me whether the fire which you employ in that way might not be better employed in producing a simple draught by withdrawing the air by machinery; employing apparatus which would remove the air on the principle of an air-pump. I should certainly prefer machinery to the simple fireplace, in order to keep the fire as much as possible from the pits.

3880. Are you aware that under the more recent practice that has obtained every possible precaution has been taken, that the air which is already in an inflammable state is separated from that freer current by which the workings are chiefly ventilated?—By means of doors, I believe, and boys, called trappers, who are

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are employed in shutting them; not very excellent machines for that purpose, for attention is not a very common quality of boyhood, nor great discrimination.

3881. Perhaps you are not aware that with the precaution already alluded to, ignition from the furnace has of latter years very rarely taken place?—I think the mine must be very badly arranged if the furnace is so placed as that it endangers by ignition. I should of course prefer it being where it could not produce it. I suppose very few instances of ignition by fireplaces have occurred.

3882. Leaving the subject of ventilation, you are aware of the value which is attached by coal-owners to the experiments and success which attended the labours of Sir Humphrey Davy, Dr. Clanny, and other individuals, who have made the safety-lamp the object of their attention?—I am quite aware of these circumstances.

3883. As a chemist, what is your opinion of the merit of Sir Humphrey Davy's lamp as an entire preventive of explosions from mixture of gases?—Sir Humphrey Davy's lamp has unquestionably great merit, inasmuch as it protects against ignition when the explosive gas is quiescent, but it is totally defective when that gas is in motion and can reach the wire gauze (the protecting substance) in that state of condensation which a moving column of gas always acquires; it then becomes no longer a safety-lamp; the flame within then passes through the meshes, and ignites the explosive compound which is without.

3884. Have you ever ascertained by experiment at what rate a column of inflammable gas must act upon the gauze cylinder to produce explosion after mixture?—I have not; the ordinary rate, however, at which it flows from the orifice of gas lamps used in lighting houses and shops is quite sufficient for that purpose. For long before I was aware of the fact more decisively, I saw experiments which were made with the wiré gauze on gas issuing from such orifices, under the common pressure of the public gasometers, in which, long before the wire gauze had acquired that temperature at which Sir Humphrey says it is no longer safe, ignition took place through the wire gauze. I was not then aware that it was owing to the motion of the gas, but I now know it is from that circumstance. At the ordinary rate therefore at which it flows through the pipes of this metropolis, the velocity is sufficient to produce ignition; and, consequently, with the greater velocity of a blower in a mine, ignition must be quite unavoidable.

3885. What is your private *rationale* of the principle on which Sir Humphrey Davy's lamp acts as a protection?—I have always been satisfied that it was by the metallic tissue reducing the temperature of the flame so much, that it was incapable of occasioning ignition in contiguous portions of explosive gas. I have seen no reason to doubt that it is the cooling process by conduction and radiation of the wire gauze that the temperature is rendered inoffensive in respect to the ignition of the adjacent portions of gas; it is therefore by a cooling process.

3886. Would that opinion be confirmed by an experiment showing the perfectly cold gauze being used, a jet of gas would explode immediately on the lamp being exposed to it?—Yes; because the heat of that jet or current of gas becomes so great, that notwithstanding the cooling effect of the gauze, it keeps up an igniting power equal to that required for inflaming the gas on the other side.

3887. Then, standing on the opposite side of the gauze, would you expect to see a change towards red heat in the gauze previously to explosion?—If the gas were quiescent, but not if it were in motion, for in the experiments to which I have alluded the wire gauze did not become red hot, and I was in the act of stating that the flame would not pass until the wire gauze did become red hot, when the flame actually passed, the gauze not being red hot, to my very great surprise.

3888. Do not you consider it a point of practical importance to ascertain what the velocity of a current of gas must be, previously to its exploding beyond the lamp, inasmuch as a miner taking alarm, as he ordinarily does, at the gauze being red hot, might have delayed the removal of his lamp, under the impression that he was still in safety?—Certainly; but I conceive it the less necessary, because the same safety may be obtained, without any risk, even from air in motion. If we were reduced to the necessity of continuing the Davy-lamp, then I think that ought at once to be ascertained; but if we can manage to form a lamp which will bear the currents, as well as the stationary condition of the explosive compound, that necessity is at an end.

3889. It is usual in mining to bring down two or more cubic yards of coal at one fall; can you conceive the falling of such a body would cause a concussion sufficient to ignite a very explosive atmosphere at the lamp?—I can; for the

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weight of such a mass of coal will produce great compression, and that very compression produces the same condition as to superior facility of ignition that the motion of air in a current produces. I conceive the current produces its effect by the gas being compressed, and therefore becoming more combustible; it is gaseous matter containing within the same space a greater quantity of the combustible, and it may therefore be said to be of a higher combustible quality; so if it is compressed by weight from the gasometer supplying a burner, that same condition of the gas, the higher degree of combustibility, and the consequent greater degree of heat, would arise from that simple and more slow compression, as by the falling of a heavy body on the mass of the air.

3890. Then you could suppose a case in which the atmosphere of the mine was not so inflammable, the moment the coal was thrown down, as to show any explosive effect in the gas, and the atmosphere being rendered still more explosive by the gas being discharged from the coal, the gas might explode without giving warning to the men?—Certainly; there would be no warning unless the miner had been instructed what would occur to the gas; it must be a warning of intelligent inference if it existed at all.

3891. You are aware that many of the accidents that have occurred in mines where the safety-lamp has been in universal, or all but universal use, remain entirely unaccounted for?—Yes; they never have appeared to me to be satisfactorily explained, for in general those who suffer and must have known all the circumstances, were rendered incapable of communicating what they knew.

3892. Have you ever had the curiosity to enter into a consideration which would afford rational conjectures as to the manner in which such accidents may have occurred?—No, I have not; I have not had an opportunity of seeing in detail any account of those accidents, but I have always observed it stated that nobody could tell how they happened. They assumed that the Davy-lamp was a perfect safeguard, and therefore they were totally at a loss to explain the occurrence which had taken place; and I have never yet been enough acquainted with the minutiæ of those events to understand their causes.

3893. Have you had an opportunity of comparing Sir Humphrey Davy's lamp with others recently suggested, so as to form an idea whether any improvement—practical improvement—may be made in Sir Humphrey Davy's lamp?—I have; and I have found that a very great practical improvement may be made and has been made.

3894. Would you define the nature of the alteration which you would be inclined to suggest as to such improvement?—I should certainly suggest as an important alteration, the non-admission of air through the surrounding cylinder of wire gauze; that appears to me to be a primary point; then I should certainly suggest that the quantity of air by which the burning body producing the light is supplied should be limited, and should be so directed that it can be employed only in igniting and continuing to ignite the burning body from which the light is to be obtained.

3895. Have you ever seen an improvement in the Davy-lamp proposed by Messrs. Upton & Roberts?—I have.

3896. What is your opinion of the merits of it?—It appears to me to comprehend all the points that are essential to safety, viewing it theoretically: and having exposed it to every requisite trial, and indeed to some trials of great severity, and always without the slightest appearance of the passage of flame from the interior of the lamp externally, I consider it to be perfectly safe.

3897. Do you intend to state, that no explosion was produced in the course of these experiments, under contingencies in which the Davy-lamp would inevitably have exploded?—Certainly I do; for when the same experiments in which the flame passed through the cylindrical wire gauze of Davy's lamp, and ignited the gas exterior to it, were repeated with the lamp of Messrs. Upton & Roberts, the gas which was exterior was not ignited. The gas externally was not ignited in any of the often-repeated trials.

3898. As Messrs. Upton & Roberts have had an opportunity of explaining their invention to this Committee, will you give us your opinion as to whether the flame from their lamp, naturally elongated on coming into the presence of carburetted hydrogen, would not act with great force, on the principle of a blowpipe, against the upper strata of the gauze?—It would not; for there is neither a sufficient quantity of inflammable matter, nor of the supporter of combustion, to make it a very great or long flame. It never has been, in any of the instances I have

seen, a flame reaching nearly to the upper stratum of the gauze; but there is another circumstance which prevents its producing much effect on the gauze, that there is no gaseous matter in actual ignition in contact with that gauze, as is the case with Davy's lamp. At the upper part above the flame, that is at the upper part of the cylinder, there is nothing but azotic gas and carbonic acid gas, and there it is impossible any flame could exist; and consequently, no extraordinary heat can arise.

3899. In the experiments you have made or witnessed, what in point of fact was the appearance and position of the flame in Messrs. Upton & Roberts's lamp, while immersed in the inflammable atmosphere?—It always gently, slightly elongated; but it was so little, that if it had been a question whether any carburetted hydrogen had been supplied to it or not, it would reasonably have been matter of doubt, if one had not seen it was actually administered. Because the quantity of oxygen supplied is very little beyond what is necessary for combustion of the wick of the lamp, there could be very little additional combustion going on.

3900. The Committee presume, that the gases used for these experiments were chemically prepared; do you apprehend the proportion was as similar as possible to what is known by the name of coal-damp?—Certainly; for they were prepared with as large a quantity of the carburetted hydrogen in proportion to the atmospheric air, as is generally employed in experiments, and the gas used was coal gas, gas obtained by the distillation of coal, which we have every reason to conclude, not only from Dr. Henry's experiments, but from the fact of the gas having been so obtained, that it must be very much like the common fire-damp of the mines. Dr. Henry, by experiments with coal gas as it is ordinarily prepared, and with that which is obtained actually from mines, has shown their almost perfect identity. I conclude with confidence, that there is no want of identity to affect the experiment.

3901. Next, as to the important alteration of surrounding the gauze with a lens; do you attach importance to the application of a brass collar, directing the current in the wick?—I think that is the most essential part of the improvement: there is an ingenious use of the wire gauze made beneath the wick, which I will point out. (*The Doctor here referred to Messrs. Upton & Roberts's lamp upon the table.*) We have here the wire gauze, which we make of as fine a texture as we please. I hold in my hand wire gauze having 60 wires in the space of one inch, that is 3,600 apertures in the space of a square inch; but that is not all: this is double, and the two surfaces can be separated from each other, so that they may be perfectly cleaned without disturbing them, and when brought over each other in the manner in which they are now placed, it will be at once perceived, that they intersect the spaces, and consequently we have in each square inch 7,200 apertures, instead of 3,600. If this were to surround the flame, it would have completely defeated the purpose of the lamp, for no light would penetrate it, but at the bottom of the lamp; we do not want it to let light pass through, but as a filter to obstruct the flame, or to allow no flame to pass from above to below, which it certainly does prevent in the most effectual manner. Then the conical cover is placed immediately above the flame, which by directing the whole of the air which enters at these apertures, loaded of course with the quantity of combustible matter which the air at the time contains, and directing that air entirely around and above the flame, it secures its perfect ignition, and its ignition likewise at that particular spot. If there happens to be too much of the combustible gas, the flame of the oil would diminish, and perhaps it would, as is the case of Davy's lamp when the quantity of gas is great within, cease: and the combustion principally would be that of the gas; but in this lamp, in this portion of air only combustion takes place: and that constitutes a great part of the security; and is the result of the cone, this particular contrivance.

3902. Have you ever found the flame entirely expire in any combination of gases?—Yes; when we use an explosive compound, that is to say, if we take the proportions Sir Humphrey Davy stated to be most explosive, seven or eight parts atmospheric air to one part of carburetted hydrogen gas, then on forcing air through these apertures there is a little increase of the flame in the moment of contact; there is then an explosion, just audible, and the lamp goes out.

3903. Do you apprehend an increased portion of carburetted hydrogen gas would or not produce the same effect?—An increased proportion probably diminishes the explosive quality. It is said explosion takes place with different degrees of violence between six and 12, but the greatest violence of explosion is about

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seven or eight; when you go beyond there is very little explosion; at 13 or 14 simple combustion; and even at 30, that is, if the proportion is 30 to one, there is the slightest, the faintest appearance of combustion.

3904. But in what proportion of the smallest compound of carburetted hydrogen do you apprehend explosion would extinguish the lamp?—I think not less than the proportion of one of carburetted hydrogen to six of atmospherical air. I think the explosion would be too weak in a lower proportion than that.

3905. Do you apprehend the lamp would continue burning in a compound of 1 to 12?—Yes; or 1-15th, 1-13th, or 1-14th.

3906. It is the explosion which extinguishes the lamp?—Yes.

3907. The practical result would not be the extinction of the lamp in all cases of its approaching an inflammable compound?—No; therefore the lamp is an advantageous lamp, enabling the miner to go on working in a portion of air enough contaminated to burn, but not so much as to explode.

3908. Then the precaution which is taken, or which is asserted to be taken, of compelling the men to withdraw from work the minute their lamp, the Davy-lamp, becomes red-hot, would not be necessary in the use of that lamp, the light being still preserved with safety?—Certainly not; there would be no occasion to do so, there would be nothing put into any condition by that circumstance which would render it capable of disturbing the atmosphere extraordinarily.

3909. Now your opinion is that, independently of contingencies which might entirely destroy the structure of any lamp, that lamp is in every respect more useful, and better entitled to the name of a protection lamp, than any other you have seen?—I have not the slightest doubt of it.

3910. Have you ever thought how far it would be possible for the gas to ignite between the lens and the wire, by perpendicular pressure downwards?—I am persuaded it would not; for the effect of any body of air pressing downwards against the ascending column, would either be to stop that ascending column, and therefore prevent the further admission of air from without, or else, by forcing down carbonic acid gas and nitrogen on the flame, it would put it out, decidedly put it out. Here is a cap which goes over the dome of the glass, which directs the whole of the ascending column; if the air should be pressed down into the cylinder, being in its nature not pure enough to support combustion, it would put out the lamp effectually, therefore it could not be ignited.

3911. Would you anticipate great risk of the fracture of the lens from the alteration of heat?—The fracture of the glass cylinder? No, for there never is a very great degree of heat within the cylinder, the quantity of matter in a state of ignition not being very great.

3912. Did you ever break the glass in the course of your experiments?—I have seen experiments repeatedly performed, and I have seen the lamp burn an hour or two at a time. I remember detaining the experimenter very long on one occasion; the lamp continued to burn for more than two hours, yet the cylinder was not at all hot, and was not injured in the slightest degree.

3913. Do you think a drop of water falling from the roof would cause a fracture?—I think it scarcely would, for the heat of the glass is not sufficient to produce that effect. It never could become red-hot, or nearly so hot as I was accustomed to make glass, when I wished to break it by that mode. Suppose it were broken, we have the same protection by the gauze-wire cylinder as belongs to the Davy-lamp. We are put into the same condition with the Davy-lamp, but no worse.

3914. Have you ever thought on the subject of how far it would be expedient to form the lens of talc in lieu of glass?—No, it has not occurred to me, having a sufficient quantity of glass, and a small supply of talc; glass being also more transparent than talc, and glass being more soft when heated, and much more easily brought into the desired form, I see no ground for adopting it in preference to glass, except from the circumstance of its being less disturbed by the alternations of heat, which I believe is of no importance in these particular cases. But I find that Messrs. Upton & Roberts have introduced a double cylinder; in one instance they showed me a lamp provided with a double glass cylinder, which would make the difficulty, from the liability of the glass to fracture, still less considerable. There are two cylinders, as you perceive, the cylinder immediately above the wire-gauze, and there is a larger cylinder without, which passes over, and which must complete the protection of the interior against its being disturbed.

3915. Would any objections arise to the use of a larger lamp and with a larger

larger area of gauze, with the precautions now suggested?—Not in the least; for if we take a lamp of this description, and even much larger (*referring to one of Upton & Roberts's on the table*), it is found, by a very simple experiment, there is no difficulty arising from that circumstance of magnitude. If we light a taper and place it in any part of this circumference, in any part of this lateral space, that taper in a very short time becomes enveloped in a gas which will not support combustion, and it goes out; therefore I do not see that the enlargement of the space will be any disadvantage to the lamp. It would be less portable, and less convenient for the miner to carry about with him, but not less safe.

3916. But the miner having considered himself very properly circumscribed by the size of his lamp, (we are now speaking of the Davy-lamp,) and objections in practice being started on account of the inferior light produced by that lamp, would not the introduction of a larger lamp be both convenient and expedient, with a view of overcoming the prejudice of the miner in favour of candles?—I think decidedly so. If anything is to be gained, either by the removal of darkness, or that which is analogous to it, prejudice, I think it would be very desirable that a larger lamp should be employed.

3917. If the coal proprietors of any district in England found the men object to the lamp on account of the diminished light it affords them in the prosecution of work, that might be overcome by a safety-lamp constructed similarly to that now before you?—It appears to me that such increase would not be in danger of increasing the defects which are to be obviated. I do not see, therefore, why it should not be used.

3918. The risk would be simply confined to breaking both the glass tubes or lenses?—Yes; that would be the only risk.

3919. Have you ever considered if it was possible, by a chemical process, to neutralize this inflammable gas?—I do not think that any chemical process which is at all likely to be applicable to practical purposes could be introduced with that view. The only chemical process which can destroy it, is that in which all its danger consists; that is, combustion. If there were any mode of burning the gas *gradatim*, instead of at once exploding it, the simplest of all protection would be a slow and gradual combustion of the enemy. But as that is a plan which has never yet been found to answer (though I believe it has been attempted repeatedly), it can hardly be spoken of now; and then there is always this difficulty, the greatest of all the difficulties, the sudden introduction of large quantities of this gas, by breaking through the walls within which it is restrained. When you are in a deep mine, of course the elasticity of the gas is much greater, and I believe the quantity is greater too; and if you penetrate into strata, of which a part is occupied by gas, the force of the effluent gas, and the quantity of it, would constitute the great danger against which your previous precautions appear to me quite incapable of giving you any security.

3920. It is in evidence before the Committee, that some mines have been found highly inflammable under certain indications of the state of the atmosphere by the common barometer, and that they have alternated with the relative pressure of the atmosphere; can you state if there is any instrument indicating still more delicately the changes in the pressure of the atmosphere, that has come under your observation?—No, there has not, certainly. I know of no practicable test that I can refer to, by which these changes could be better ascertained.

3921. It has been found valuable in one or two instances to require the man having the immediate charge of the mine to make a more frequent inspection of the barometer; could you suggest any other experiments by which the pressure of the atmosphere could be more accurately defined on the instrument?—It does not occur to me at this time; it is possible an instrument, something like what has been employed in experiments with the air pump, the manometer, might be made use of.

3922–3. Can you suggest any improvement in the construction of the present barometer which would indicate more accurately the change of atmosphere?—It is very easy in a case where the elasticity of the gas constituting the blower has acquired very nearly the same degree of force as the elasticity of the air without, and that when it appears that the air without is singularly light, the elasticity of the accumulated carburetted gas is sufficiently preponderant to work the blower when the pressure of the atmosphere is great, then it overcomes the elasticity of the carburetted hydrogen gas and keeps it in its cavern. In a case of

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that kind it would be easy to get a much more instructive indicator than the barometer. A tube might be connected with the cavity, that should have communication by means of a bent tube with a proper part of the water barometer. The movements of a water barometer are much greater than those of the mercurial barometer, because water is of much less specific gravity than mercury. When the barometer indicated the change of one-tenth of an inch, the water barometer would indicate the change of 13 or 14-tenths of an inch. The tenth of an inch, which is easily perceived, would by the water barometer indicate a change, which by the ordinary barometer could not be exhibited at all, even by the assistance of the vernier; and in the case described, I should at once attach such an arrangement as would give me the indications of the water barometer instead of the mercurial barometer. I should then become aware of the changes referred to, with the greatest certainty and facility.

3924. To individuals whose attention is merely called to the mercurial change, as felt on the barometer, the water barometer would be a decidedly preferable instrument?—Decidedly; and answer every purpose, and would give the indications quite sufficiently large and prompt for every purpose of the observer.

3925. Are you acquainted with any instrument by which the velocity of a current in a confined chamber may be accurately ascertained?—Not of any one that is very valuable; for even at the present time we have not an anemometer, or instrument to measure the currents of the atmosphere, on which any strict reliance can be placed. I believe there have been small instruments invented to ascertain the velocity of a current of air rushing into a vacuum, which answered tolerably well, but of a kind that will not serve practical purposes.

3926. The area of a mine being given, and a standard also being given of the quantity of air required to ventilate that area, is it not a desideratum in mining to have an instrument that would at once indicate if the necessary supply is afforded? Undoubtedly; and it is (if no such instrument does exist) a very great defect in what one would hope to have at this day, a tolerably perfect state of ventilation. Practically, there is no state of ventilation which I should not expect was tolerably perfect.

3927. Are you aware that the only means the most eminent miners have of ascertaining how far their air-current is in any given state, that is, the state in which they intend it to be, is to reckon by a stop-watch the number of seconds in which a candle of given dimensions is extinguished?—No; I was not aware that they had advanced no further. I did not know that they measured ventilation by a candle, any more than the duration of a sale by the burning of a candle. In respect to ventilation, as it regards one part of the necessity of ventilation, that is to say, the removal of carbonic acid gas or choke-damp, which though not constituting so large an object in the consideration, is, nevertheless, a very important one, I would observe that there has been invented a particular apparatus by which, on taking the whole subject of accidents in mines into view, it may not be improper to say that considerable safety will be secured, provided it is employed. I allude to a hood invented by the same ingenious individual who has so greatly improved, who has in fact, I think, perfected the Davy-lamp. This hood I had an opportunity in 1824 of trying most thoroughly in a building constructed for the purpose. The effect was very satisfactory. Since that time it has been very much improved, and it would, I believe, enable the miners, after an explosion has occurred, and in cases where no explosion has occurred, but where carbonic acid gas prevails, to enter into the mine and carry away the bodies that may have been damaged before life is extinct, and to enter always into spaces otherwise unapproachable, and therefore greatly diminishing the chances of those terrible disasters to which miners are exposed. In its completed state, if it be the wish of the Committee, I will cause it to be exhibited.

3928. The Committee have had from the inventor not only a description, but the opportunity of inspecting the implement; they wish, nevertheless, to have your opinion of its value as a mechanical instrument, as well as on the principles on which it is assumed to act?—When it was first employed, it was merely for the purpose of separating the noxious fumes of a space filled with destructive vapours, such as burning wood, burning sulphur, and so on, which was accomplished by making the air that should pass into the lungs pass first through a long tube, after passing through a sponge moistened with water, which washed the air and rendered it respirable. Now, however, that plan is extended by making the air pass through a space, a kind of canister, which is

moist, and which can be made to contain chloride of lime, or any other substance, to destroy the noxious vapour. There is a valve to prevent air passing through that tube downwards, and a valve which allows air escaping in expiration to pass out with great facility and with great convenience to the persons wearing the hood. It appears to me in this state,—with these additions to apply to the end of the tube; and this valve, which is the valve for expiration, for allowing the air to pass out when it has been employed, and which does not allow it to enter; and with the other valve, situated in the nozzle, which allows the air to enter after being washed in the canister and rendered fit for the respiration of the individual; and producing a method of enabling a person to breathe among gases, or in sewers, or in any place containing foul air with facility,—to be in a most useful and almost perfect condition. There is the expiratory and the inspiratory valve operating, so that whilst the canister is applied the air that is used cannot pass through the tube, whilst none but the washed air can find admission to the lungs. The individual can move with ease and safety by means of the sights. This appears to me to complete the safety of the miner, (as the lamp is not to protect him against carbonic acid gas, which is an agent destructive to life, but to protect him against the other enemy to man, carburetted hydrogen gas); it enabling him to pursue his occupation with a sufficient quantity of light, without the danger of igniting the gas around him.

3929. The Committee would like your opinion as a gentleman long in practice as a medical man, if you anticipate any unfavourable consequences to a man engaged in the working of mines; to the health of men engaged in the working foul mines?—I think it very probable that the health would not be quite so good; for it is possible that the mode of freeing the air may not be quite complete, and perhaps respiration constantly going on under the constraint of that apparatus would not be quite so commodious as in the atmosphere at large; but otherwise, I do not know that there will be much disadvantage.

3930. The question had more especial reference to the combination of carbonic acid gas, or carburetted hydrogen gas, as existing in the mines?—I believe from experiments that have been made, that if the quantity of carburetted hydrogen gas is not so large as to render the air unrespirable, the inconvenience is not great. That small quantities of carburetted hydrogen gas do not much affect the senses is certain; but the experiments of Mr. Watt, made some time ago, showed, that if you breathe a few times from a vessel full of carburetted hydrogen gas, the power of the brain will sink rapidly. It is an exceedingly poisonous gas, speaking of a poison in reference to respiration, if the quantity is considerable; but I believe that one or two parts in a hundred of the atmosphere, which is a very small quantity, does not produce any very injurious effects.

3931. You consider that the constant working in an explosive mixture would be extremely injurious to health?—I think the constant working in an explosive mixture might subject the individual to some of the mischiefs arising from the application of carburetted hydrogen gas to the surface of the lungs.

3932. Is not the introduction of Messrs. Upton & Roberts's lamp to be rather dreaded, considering the anxiety of coal-owners to obtain all the coal they can, and make as much coal be raised as possible?—The introduction of this lamp may probably enable them, by taking advantage of its superior qualities, to gain additional profit; but they would soon find that allowing their men to work in an unwholesome atmosphere would be attended with this disadvantage, that health would be deteriorated, and the wages would rise, on account of the unwholesomeness of the process. The danger attending the process of mining, I believe, occasions an addition to those expenses charged as the wages of the miner; and if it were found that the gas of the mine was adding still to the mischief of mining, the coal-owners would be driven to pay higher prices, and there would arise to them less advantage from their mines.

3933. Do you apprehend there is any greater amount of wages paid for the work being done by the piece or by weight, in those mines which blow up almost periodically, when compared with those in which no such accidents have occurred?—I believe it to be the case. I remember an eminent professor of political economy taking advantage of that fact (if fact it be), to show, among other things, what constituted the value of labour: whether that was truly introduced or not I am not adequately acquainted with the particulars of the prices paid to colliers to say, but I suspect that it is the case.

3934. Would you suppose it possible for an individual at one inspiration to

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receive such a quantity of carbonic acid gas into his lungs, as to fall senseless instantaneously?—Not at one inspiration; for the quantity of oxygen still remaining on the lungs is sufficient to supply the necessities of the system for some time. You cannot by one expiration, nor even by five or six expirations, get out all the air from the human lungs; it cannot be so easily effected, for you do not empty the lungs at each expiration. I believe the quantity of air expelled in an ordinary expiration is about 28 cubic inches, and that in a forced expiration you can expel upwards of 100, so that you cannot put an individual under the entire influence of carbonic acid gas at one inspiration.

3935. Would the same arguments apply in the case of the inspiration of sulphuretted hydrogen?—Probably not; I think that it is still more offensive or poisonous. The experiments of Orfila and Christison show that the sulphuretted hydrogen is rapidly destructive of animal life.

3936. Would there be any decided difference in the *post mortem* appearance of a subject whose death had been occasioned by carbonic acid gas and sulphuretted hydrogen gas?—I am not quite certain. I rather think that there would be a little difference in the appearance of the mucous membrane of the lungs; there would be a little more flushing of that membrane with the sulphuretted hydrogen than with the carbonic acid gas, which has by many been supposed to destroy simply by the exclusion of the atmospherical air.

3937. What would be the difference in the *post mortem* appearance of an individual who had died from what is vulgarly called suffocation, and one poisoned by the breathing of carbonic acid gas?—If the individual died in a vacuum the appearance would be precisely or very nearly the same as if he had died in an atmosphere of carbonic acid gas. Suffocation by the abstraction of the air, as by the air-pump, or by the exclusion of the air, as by the interposition of carbonic acid gas, would, I believe, be precisely the same.

3938. The answer applies as well to external as internal appearances?—There might be some little difference in the degree of infarction of the lungs, but so slight, that it has never, I believe, been insisted on by those who have written on the subject.

3939. Would there not be a decided difference in the appearances, provided the party had been exposed to an atmosphere in a state of ignition, and to carbonic acid gas?—Certainly; the external appearance would indicate that. The external appearance would pronounce upon the ignition, and wherever ignition had taken place, and the individual was involved in the ignited matter, there can be no question about the mode. Whether the combustion was the sole cause of destruction or not, might still be a question; for if an individual were left half dead in an atmosphere of carbonic acid gas, that atmosphere of carbonic acid gas would complete his destruction.

3940. Would you approve of the system or the plan pursued in the collieries of administering powerful emetics to parties suspected to have been rendered insensible or deprived of life, or nearly so, by the agency of carbonic acid gas?—Certainly not. In the first place, it would be absurd to look for any efficacious mechanical effort from vomiting; and in the next place, if such an effort could, under such a state of system, be induced, I think it would increase the distress of the brain, which constitutes the mischief itself, that is, it would tend to oppress the brain still more.

3941. Still more you would disapprove of the practice of carting them over the roughest roads in the neighbourhood?—Oh, certainly; there is no foundation for any such practice. I believe the only plausible method would be to produce something like respiration, by mechanically enlarging the chest, and allowing a little oxygen in the common air to flow in and to fill the space. If you mechanically accomplish that by a change of atmosphere, and employ a gentle internal stimulus to the stomach, (and a little mustard diffused through water, not acting as an emetic, would answer the purpose,) you might reproduce that condition of the brain, which, I believe, would be followed by an action of the heart. If once you could regain a single pulsation of the heart, you might go on to resuscitate the individual.

3942. In your last answer have you given the Committee your opinion of the best means of proceeding, in the absence of medical advice, to recover a person whose vitality was suspended by the inhaling of carbonic acid gas?—That is the mode I should pursue if I had it to perform, and I think it is the best for general or popular practice. It has just been suggested to me, by one very well acquainted with the subject, that there may be a positive power of destruction in carbonic acid gas,

gas, upon a very feasible view of the matter. Because, it is said, the atmosphere which consists of 20 parts of oxygen and 80 of nitrogen is not poisonous, while 80 of carbonic acid with 20 of oxygen would be so, the simple exclusion of oxygen cannot be the entire cause of that destruction of life. I admit the force of that statement, and can only say with respect to it, that there is but one circumstance which would constitute an obvious difference: the carbonic acid gas may act as an extraneous matter as to respiration; and everything extraneous seems to be injurious to the system when applied to the lungs. Carbonic acid gas may be particularly injurious on that account, while nitrogen, the appointed diluent of the oxygen of the atmosphere, would be fitted for the service to which it was applied. Carbonic acid gas is not usually found in any part of the atmosphere in a quantity exceeding the 100th part; but if in the proportion of 80 parts in 100 it is destructive, it is injurious in a degree of which I was not aware; I thought it might have been breathed in that quantity without being poisonous.

3943. Are experiments on the nature of flame and the composition of gases constantly performed in the institutions of this metropolis?—Very frequently indeed.

3944. Do you think there would be any difficulty in inducing scientific men to visit and descend the mines of this country?—No, I think not at all; not any difficulty.

3945. Do not you think there is great encouragement to hold out such inducement on the part of Government or the coal-owners and that body, seeing the results that attended Sir Humphrey Davy's visit to the mines?—I think the matter now under inquiry can scarcely be completely investigated without some such encouragement or the appointment of a commission. I think there ought to be a scientific commission appointed to visit and examine the whole matter of practical mining.

3946. As the leading patron of the Mechanics' Institution in the City, do not you think the best consequences might be anticipated from the formation of Polytechnic Schools or associations of that description in the mining districts?—Unquestionably, the very best consequences.

3947. Are you aware that Cornwall has already taken the precedence, and has got an establishment of that description?—I am; and I am very much delighted to see it.

3948. Would not your own experience lead you to believe that the great mass of native talent would be brought to bear on these subjects by the encouragement held out by such institutions?—Unquestionably; and the lamp before us (Messrs. Upton & Roberts's) is a proof of the efficacy of combining native talent with the exercise of the art of the miner. Probably, without that combination, the present improvement would not have existed.

3949. Would you anticipate any difficulty on the part of a popular lecturer in making the subject understood even to an ignorant company of miners, previously very ignorant as to general information?—Not the slightest difficulty.

3950. Do you not consider such information due to men whose lives are daily hazarded in those mines?—I think it unquestionably due to them.

3951. Are there any societies in London possessing sufficient means to reward any inventions, such as have already been pointed out in lamps, or mechanical means of ventilation?—There are not any societies with means sufficient to reward such inventors. The Society of Arts does give rewards, but they are by no means sufficient rewards.

3952. Would you recommend to the coal-owners (as in many districts they are a body of wealthy individuals) to place any sum of money at the disposal of such a society as the Society of Arts, for the encouragement of such inventions?—I think it would be an excellent and a very productive stimulus if it were done.

3953. Would you think the 500 guineas recently voted to the sufferers at Wallsend, by the coal-owners of that district, better employed as a stimulus to prevent than make up the terrible loss of lives?—Certainly a preventive charity would be much superior to a charity of that description. And in order to show how much may be done by the combination, which is alluded to, I will mention one circumstance, not belonging to the subject, otherwise than as regards the protection of one class of labourers, who suffer exceedingly from the mode of performing their labour, I mean the shoemakers, who have for a long time been endeavouring to devise a method of stitching their shoes in an erect position, instead of the awkward sitting position in which they are commonly placed. There have been

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many attempts by persons who have been shoemakers to do it, and they have not succeeded, as they have not been mechanics. Others, who have been mechanics, and who have not been shoemakers, have been equally disappointed in their attempts. But there is a shoemaker who is also a mechanic, and he has attempted it, and he has succeeded. A Mr. Holmes, who has been from its commencement a member of the London Mechanics' Institution, and who while a journeyman shoemaker gained a prize for an admirable essay on the Properties of the Lever; and not long after he was so fortunate as to obtain another, for an excellent essay on the Properties of the Inclined Plane. Pursuing his work with undiminished ardour as a master-shoemaker in high repute, he has employed his mechanical attainments in his trade, and two or three days ago he showed me a machine invented for the purpose before noticed, which is quite complete. I believe that no man, not comprising the two qualities of that individual, could have produced it; at least, no individual not having so combined those two qualities had previously been able to produce it. He says, as to himself, it is of little value; he is now a master; but that if 14 years ago he had possessed such a machine, the comfort and benefit, and power which he would have possessed, would have been incalculable. I mention this fact in verification of the value of the proposition which the honourable Chairman of this Committee has thrown out, respecting giving information to the men who are actually handling the pick and the spade in the mines themselves; by whom that information would be at once applied to the most beneficial and important purposes.

Martis, 21° *die Julii*, 1835.

RICHARD EDENSOR HEATHCOTE, ESQ. IN THE CHAIR.

Jonathan Pereira, Esq. F. L. S., called in; and Examined.

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3954. WHAT is your occupation?—I am by profession a surgeon; and have been engaged for some years in the delivery of lectures on chemistry in the medical school of the London Hospital, and in the Aldersgate School of Medicine.

3955. Has your attention been at all directed to the accidents which have taken place in the mines of this kingdom?—Only in reference to the lamps used.

3956. Have you made any experiments on the lamps?—Yes; I have made a considerable number of experiments during the last three or four years.

3957. On the lamp invented by Sir Humphrey Davy?—On his lamp, and also on an improvement of it.

3958. What is your opinion of Sir Humphrey Davy's lamp, as a security against the effects of carburetted hydrogen gas?—I do not think it is a security, because the lamp will allow the passage of the flame through it.

3959. Will it allow the passage of the flame when suspended in the carburetted hydrogen gas, without motion?—I have never seen the flame pass through the wire gauze when the lamp was at rest, and the gas not in motion. Under such circumstances the lamp may be safe, at least I have never seen it explode.

3960. Have you seen it explode under other circumstances?—Repeatedly, when the lamp or the gas has been in motion. I was accustomed for years to show the Davy-lamp in lecture, and by certain experiments to demonstrate, as I then thought they did, the security of the lamp. The experiments are those usually shown in the lecturer-room. I am now convinced they are fallacious. There are three methods mentioned by Sir Humphrey Davy, of proving the safety of the lamp: the first method (mentioned at p. 14, 15 of his work, on the "Safety-lamp for Coal-miners,") is to plunge the lamp into an explosive mixture contained in a large vessel; the second method (mentioned at p. 16 of Davy's before-mentioned work,) is to hang the lamp in a large glass receiver, through which a current of explosive gas is made to pass; the third method adopted by Sir Humphrey Davy, was tried on a "blower" in a coal mine. He held the lamp in this blower, and though the wire gauze soon became red hot, the flame did not pass until the gauze had reached a welding heat, and began to burn. (This is mentioned at p. 138 of his work.) Of course lecturers in London have no means

of

of exposing it to a blower, and therefore they have usually employed as class-room experiments the two first-mentioned methods of trying the lamp. I have never found the lamp explode by either of those methods; but, as I have already remarked, they are fallacious experiments.

3961. You think the lamp, if exposed to a current of explosive gas, decidedly unsafe?—Yes, certainly. I will not say it is absolutely safe when the lamp is not moved, and where there is no current; but under such circumstances, I have never seen it explode. I may perhaps mention in what way I became convinced of the insecurity of it. Mr. Roberts (who I believe has been examined by this Committee) has been employed by me for some years as a manufacturer, &c., of lamps; and on several occasions he told me that he was certain the Davy-lamp was not "a safety-lamp." Although I was aware that Roberts had particularly directed his attention to this subject, and from having been a working miner for many years must have been practically well acquainted with the lamp, yet as he was not accustomed to the niceties requisite in conducting chemical experiments; as I and many others had tried the lamp, and as far as I then knew, it had always been found a security against the passage of flame, I confess I thought Roberts was labouring under an error. At his urgent and repeated request, I ultimately consented to attend at Upton & Roberts's manufactory, to see him prove, if he could, the insecurity of the lamp, though fully persuaded that I should be able to find out some fallacy in his experiments. In a few minutes he showed me that flame might be made to pass through a Davy-lamp; but thinking that the lamp he employed might not be perfect, I sent for one which I had repeatedly tried, and which I knew to be a perfect instrument. The flame passed through this also. Subsequently I tried the Davy-lamps of some friends, and in every case they allowed the passage of the flame. I then undertook a series of experiments, the result of which is a firm conviction of the insecurity of the Davy-lamp when in motion, or when placed in a current of explosive gas. I think we may easily comprehend why the flame does not pass when both the gas and the lamp are at rest: it depends on two circumstances, namely, the less heat developed in consequence of less gas burning; and secondly, the carbonic acid formed not being got rid of, checks the passage of the flame through the wire gauze. I think, however, that the latter is the most efficient cause, since the gauze will allow the passage of the flame when it (that is the gauze) is not hot enough to be luminous, so that a great heat is not essential. Now when a Davy-lamp is plunged into a jar of explosive mixture, a quantity of carbonic acid is immediately formed, and this mixing with the unconsumed portion of the explosive mixture, diminishes its combustibility, and therefore its explosive powers. If, on the contrary, you expose the lamp to a current of an explosive mixture, the carbonic acid which is developed is immediately got rid of, (as well as the nitrogen of the portion of atmospheric air employed in carrying on the combustion,) and then the flame passes. A gentle motion of the lamp, combined with the current of the gas, very much promotes the passage of the flame. If, for example, a lamp be held before a jet of gas until it becomes hot, (a red heat is not essential) and then gently moved, the flame will pass, and the experiment may be repeated successively a number of times in the minute. Sir Humphrey Davy was well acquainted with this fact, that carbonic acid diminishes the explosive property of gaseous mixtures. At p. 10 of his work, he says: "On mixing one part of carbonic acid or fixed air with seven parts of an explosive mixture of fire-damp, or one part of azote with six parts, their powers of exploding were destroyed." At p. 32 of his book, Sir Humphrey Davy states that "the consideration of these various facts led me to adopt a form of lamp in which the flame, by being supplied with only a limited quantity of air, should produce such a quantity of azote and carbonic acid as to prevent the explosion of the fire-damp, and which, by the nature of its apertures for giving admittance and exit to the air, should be rendered incapable of communicating any explosion to the external air." It is evident, therefore, he endeavoured to form a lamp which should be safe from the combined influence of the carbonic acid gas, of the azote or nitrogen gas, and of the wire gauze.

3962. State to the Committee in what way you think the lamp of Messrs. Upton & Roberts is an improvement on that of Sir Humphrey Davy?—There are several points of view under which we may regard it as an improvement. In the first place, it is quite evident that the wire gauze of the common Davy-lamp partially obstructs or impedes the passage of flame through it; and, therefore, if you

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employ two layers of wire gauze, the obstruction is greater than that produced by one. Now in practice two layers of gauze are objectionable; first, because such lamps would give very little light; and secondly, because the gauze soon becomes clogged up. But even if these objections could be overcome, there exists a still more weighty one, namely, that the lamp, even with a double layer of wire gauze, is not secure. I have repeatedly passed flame through lamps of this kind; the experiment occupies a little longer time, because the flame passes less readily through two than through one; but it does pass, and therefore such a lamp is insecure. Now in Upton & Roberts's lamp only one layer of wire gauze is employed, and therefore there is little impediment to the light. To prevent the effects of lateral currents, they use a cylinder of glass placed external to the gauze. This is one improvement over the common Davy-lamp: it must be admitted, however, that Davy, at p. 136 of his work, proposed screens to increase the security of his lamp; but neither the screens of Davy, nor the cylinder of glass employed by Upton & Roberts, would of itself be sufficient to make the lamp secure. Hence, therefore, we come to the next part of the improvement made by Upton & Roberts, and which consists in the manner they admit the external air, or the explosive mixture, to the interior of the lamp. Around the lower part of the lamp is a number of apertures, through which the air passes into a chamber, the ceiling of which consists of layers of wire gauze. To increase the security of the lamp, any number of these layers may be employed; they are easily taken out and cleaned, and they offer no impediment to the light; whereas in Davy's lamp, any increase in the number of wire gauzes diminishes the light. This then constitutes a most important improvement. I now pass on to another improvement in this lamp, and which in fact constitutes its superiority to all other safety-lamps that I have seen: when the air or gas has passed through the wire gauzes, it does not pass immediately into the body of the lamp, but into a second chamber, bounded above by a conical piece of brass, having a central aperture about the size of a sixpence, in the middle of which is the wick; so that all the air passing into the lamp, is brought in contact with the wick, and thus increases the quantity of light evolved; and as the aperture is much smaller than the cavity of the wire gauze cylinder, the latter cannot fill with flame when introduced into an explosive mixture, so that the flame can never touch the wire gauze cylinder; and, indeed, between the flame and the cylinder there is no oxygen to support combustion, as may be shown by its extinguishing a taper, we have, therefore, the very condition Sir Humphrey Davy wanted, since no taper will burn in the space between the flame and the wire gauze; so that you observe we have three impediments to the lateral passage of the flame, a layer of carbonic acid, a wire gauze cylinder, and a cylinder of glass. The safety at the bottom consists in any number of wire gauzes the maker may choose to employ, and therefore if the lamp is not safe it is his fault.

3963. Then how is the top of the lamp secured?—It is made safe by layers of wire gauze, and also by having a contracted aperture to the glass, by which the draught is increased, and all the carbonic acid gas that is formed below, by the combustion of the fire-damp, or of the oil of the lamp, as well as the nitrogen of the atmospheric air, contribute to prevent the combustion of a body in this situation, for if you put a lighted taper here, it is extinguished immediately. Thus then this lamp is made safe at the sides, at the bottom, and at the top, by different methods. If the glass should break, the lamp is then a common Davy-lamp.

3964. Have you made experiments on that lamp in the explosive mixture?—I have submitted this lamp to every experiment I have submitted the Davy-lamp to, and I could never get this to explode; indeed, I have submitted this lamp to a test (oxy-hydrogen gas) which it is not likely to be put to in actual practice.

3965. This lamp then is safe in a draught or current of explosive gas?—Yes, it is perfectly safe in any current of carburetted hydrogen gas, or of this gas and oxygen, or of this gas and air. I have repeatedly tried it, and the flame will not pass. When the explosive mixture was blown in gently, the flame increased in size; if passed in with violence, the flame was extinguished, but no passage of it will take place through the gauze.

3966. Have you made any experiments in coal mines with it?—No, I have never been in a coal mine with it. My experiments were made with coal gas and with hydrogen gas.

3967. You think that the lamp would be decidedly a protection to the collier, under any circumstances to which he could be exposed from carburetted hydrogen gas?—

gas?—As long as the lamp is perfect, it is safe; but if the glass break, it would be no safer than the common Davy-lamp; as long, however, as the lamp is perfect, it is in my opinion quite safe.

3968. Has it ever occurred to you to consider whether there might be any means of neutralizing the carburetted hydrogen gas found in the mine?—It may be absorbed by chloride of lime, and the French have proposed that as a means of preventing the explosions of the fire-damp; so that there are three plans proposed to guard against these accidents, namely, by the employment of safety-lamps, by ventilation, and lastly, by the use of chloride of lime; but the last method is absurd when we bear in mind the extent of the collieries in this country.

3969. Do you think that where the air-course extends, as in those collieries, 20 or 30 miles, the application of the chloride of lime in an effective manner would be at all practicable?—It would be impossible to distribute this substance over so great an extent of surface, so as to render a mine safe, and the miner would not be able by it to counteract explosions by sudden evolutions of gas. This chloride of lime might, however, be serviceable in absorbing the gas, so as to enable a miner to breathe with safety. A flannel dipped in a weak solution of the chloride might be applied over the mouth and nostrils, if it were required to enter a chamber containing a large quantity of carburetted hydrogen.

3970. Has your attention been drawn to the other invention of Mr. Roberts, for removing bodies from the mine after an explosion?—Yes. I have frequently seen the fire-hood tried on poisonous gases, and have generally illustrated its operation in my lectures, whenever I have had to speak of the fire-damp.

3971. You think that the hood of Mr. Roberts is a useful invention?—Yes, certainly.

3972. And likely to accomplish what it professes to accomplish?—Certainly; as long as oxygen is preserved in the air to supply life, that instrument will remove several of the most noxious of those gases likely to be met with; for example, it would remove carbonic acid, sulphuretted hydrogen, carburetted hydrogen, the fumes of burning sulphur, &c.

3973. Have you ever personally visited any of the collieries?—No, I have not; I am very desirous of obtaining fire-damp for analysis and experiment, but have not yet succeeded. And here I would again remark, that all my experiments were conducted with coal gas or with hydrogen gas. Now I am aware it may be objected that the fire-damp of coal mines is not precisely the same as coal gas; but to that I would reply, that Sir Humphrey Davy thought it necessary to make the lamps safe to the test of coal gas; and, therefore, I am justified in trying his lamp with it. Secondly, I believe the fire-damp of coal mines is liable to variation, though that can be but an opinion, as I have not examined it. The opinion is founded partly on the statements of Davy, who mentions that he suspects olefiant gas to be sometimes present, and even admits the possibility of pure hydrogen being disengaged in mines, partly from the accounts of miners, some of whom have told me that the gas burnt very differently at different times. I was informed yesterday by Mr. Goldsworthy Gurney that pure hydrogen had been sometimes actually detected; and when we recollect the composition of coal, and the variable products got by the distillation of it, I do not think there will be much hesitation in believing that the gas may vary very considerably in coal mines.

3974. You think it possible that a lamp might be safe in one mine and not in another?—I do not think the Davy-lamp is safe in any of these gases, but I have not tried it with pure light carburetted hydrogen, nor with the fire-damp.

3975. Would it not be a great advantage were scientific men to descend the mines and experiment on these gases?—Very great indeed.

3976. Do you think that if a commission of scientific men was appointed, either by the colliery proprietors or by Government, to visit the mining districts, and make experiments on the spot, it might not be very conducive to the object this Committee has in view?—I think it would be desirable: 1st, for the sake of humanity; 2dly, for the interests of the coal-owners; and 3dly, for the advancement of science.

3977. Do you think it might lead to such improvements as could not well occur to scientific men without the sort of experience they would derive from personal inspection of the mine?—Certainly; it is very desirable that the man of science should acquire practical information on all these points.

3978. Have you any suggestions to offer to the Committee?—I would respectfully suggest the propriety of submitting all the lamps to trial in the presence of the Committee;

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Committee; we could soon show those which were secure and those which were not so; and this would be the most convincing method of ascertaining their relative values.

3979. You would have no objection to give your attendance?—I should be very happy.

3980. Do you know if Roberts & Upton's lamp has been tried in a mine?—Either Mr. Roberts or Mr. Upton, when in the country, procured some fire-damp from a mine, and showed the insecurity of the Davy-lamp with it, before some coal-owners.

3981. But it is not in regular use?—No.

3982. What is your opinion as to the development of fire-damp in coal mines?—It is admitted by geologists that coal is of vegetable origin; that is, causes imperfectly comprehended have led to the conversion of immense masses of vegetable matter into coal. It seems also that fire-damp is developed during the formation of coal, but is kept from escaping by the pressure of the superincumbent strata. Hence then, when coal is covered by shale, the gas is pent up and prevented from passing outwards, and such coal is generally of better quality than that found under sandstone, which is pervious to gas, and therefore which allows the escape of the fire-damp. The great elastic force which the gas frequently evinces during its disengagement from coal, proves that it was in a state of great compression, and some have even suspected it may have been in the liquid state. Mr. Hutton has even pointed out the cells, which in all probability contain this liquid fire-damp. When the compressing force is removed, this liquid is supposed to be instantly converted into gas, and hence the eructations in blowers are easily accounted for.

3983. In what way has Mr. Hutton stated that opinion?—He has published his opinions, and given drawings of the structure of coal.

3984. Do you think that in all coal there is a certain portion of inflammable gas?—I believe so; but the quantity met with is variable; and this perhaps may arise from various local circumstances.

3985. Is it your opinion that when the coal lies in an inclined position, and crops out to the surface, a portion of the gas will escape, and a mine so situated may be less liable to explosions than one placed horizontally?—I should expect this to be the case.

Mr. *George Upton*, recalled; and further Examined.

Mr. *George Upton*.

3986. DO you wish to make some addition to your former evidence given before the Committee?—I do, because I fear it possible that some parts of the evidence before the Committee relative to the Davy-lamp may lead to the conclusion that many of the mine owners and their workmen are already sufficiently aware of the circumstances under which that lamp ceases to be a protection in an explosive atmosphere. This necessary information I have reason to know, if possessed by any of these persons, except in Staffordshire, is at present confined to a very small portion of them, which is to be greatly regretted, as the want of it must daily and hourly expose a large amount of mining property to danger, and hundreds of lives to the risk of destruction. Under this impression, I trust I shall be permitted to refer to some of the evidence in question, particularly to that given by Mr. Buddle, who observes, and the observation is, I consider, important, as he has had the advantage of a personal acquaintance with Sir H. Davy, and witnessed some of the first experiments on his lamp, that it is a matter of surprise to him how any person who had read Sir H. Davy's pamphlet on flame should entertain a belief that his lamp is safe in all its uses. Mr. Buddle's condemnation of this general opinion, for general it certainly has long been, cannot perhaps be made too public, as it would no doubt prevent thousands of persons putting that lamp to trials which it now appears it was not intended to meet, and which it is to be feared they are too frequently doing, from their ignorance of the fact that there are some limits, even in its most common uses, to its protection. It is in evidence that an explosion of carburetted hydrogen gas was occasioned by some water thrown down a shaft in Staffordshire, which brought the inflammable air in contact with a Davy-lamp. It might reasonably be inferred that such an occurrence had made the colliers in that part of the country aware that the Davy-lamp would not bear the action of a current of explosive air; but this was not the case, for in March last year I visited that coal district, in company with Mr. Roberts and my son, where

we met about 40 of the principal coal mine owners and a numerous body of their workmen, who came by appointment to witness experiments on the Davy-lamp and the new lamp, when all expressed much astonishment at the passage of flame from the Davy-lamp under a similar circumstance, viz. a current of explosive air producing by its action on the wire gauze an external explosion. In fact, we found that in the whole of this extensive coal district, to the date referred to, no limit had been given by scientific or practical men to the protecting powers of the Davy-lamp. It is, therefore, to be assumed that the circumstance alluded to passed without particular notice, as probably many others have, which were equally indicative of the insecurity of Sir H. Davy's lamp.

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3987. Were none of the colliery proprietors or the workmen aware of the insecurity of Sir H. Davy's lamp under certain circumstances?—None appeared to be so at that time. Every one seemed to have an unlimited confidence in its protection. The same unlimited confidence in the protecting powers of the Davy-lamp has since prevailed amongst the most scientific persons in the metropolis that then prevailed amongst the mine owners and working colliers of Staffordshire, and it is to be feared still prevails to a dangerous extent in all the great coal mining districts. I beg leave particularly to refer the consideration of the Committee to the circumstance of the scientific men of the metropolis, amongst whom may be included the professors of chemistry at all the public institutions, having so long entertained this opinion of the perfection of the Davy-lamp, as it proves that more is necessary than the reading Sir H. Davy's pamphlet on flame to remove this impression, which now appears, from the evidence before the Committee, to be founded in error.

3988. You think, then, that accidents in mines may arise more from the insecurity of the lamp than the neglect with which the workmen are commonly charged?—I do, certainly, in the absence of any direct proof of carelessness on the part of the workmen; I consider it unjust to the workmen in this case to assume an unknown cause for that for which there is a known one. It is now known that if a very explosive mixture, such as the fire-damp sometimes is, move on the Davy-lamp with only a slight force, or the Davy-lamp move on it, flame will pass through the meshes of the wire gauze and produce explosion. It is not to be expected that the atmosphere of a coal mine, or the miner's lamp, can be often long at rest. The process of ventilation would prevent the one, and the uses of the lamp the other. Under these circumstances, I respectfully submit to the Committee, that it is most important to the mine owner, and to the working miner, that no delay should take place in putting them into full possession of the extent to which they may safely rely on the Davy-lamp for protection.

Mercurii, 22° die Julii. 1835.

JOSEPH PEASE, ESQUIRE, IN THE CHAIR.

John Martin, Esq. called in; and further Examined.

3989. ON your former examination you stated your wish to take a future opportunity of further illustrating your views on the subject of the ventilation of mines; have you any further observations now prepared?—I have made additional drawings for the purpose of illustrating those views.

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3990. Is the paper which you have now in your hand an illustration of those views, and your general ideas on the subject of ventilation?—Yes.

3991. Do you wish that paper to be read?—Yes.

[*The same was handed in and read, and is as follows*:]

"Having had the honour of examining, in Mr. Buddle's presence, his plan of the working and explosions of the Jarrow and the Wallsend collieries, I feel it my duty to acknowledge the benefit of his information respecting the numerous difficulties and the danger (unavoidable under the present system) to life and property which exist in the coal mines in Northumberland. I have likewise to express my acknowledgments for the information I have gained on the subject of mining from other practical gentlemen, particularly from Mr. Smith, Mr. Ryan, and Mr. Roberts; and after having closely attended to the evidence before your Honourable Committee, on the various difficulties of coal mining, and the different ways

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of meeting those difficulties, I am fully confirmed in my first impression of the correctness of my principle of forming a gallery round the works and commencing to mine across corner, or other ways; never running into the body of the coal, but always keeping at the outside of it, so that the air should continue to sweep round the works, as shown in my various drawings. Under these circumstances, the following observations and suggestions as to the method of working the mine appear to be necessary:

"1st. The surrounding gallery should be built on each side with brick-work; but there should be a sufficient space left between the outer wall and the outside coal, for the purpose of ventilating the headways during their formation, and more particularly for ventilating the goafs behind the works.

"2d. I propose to cut a row of large square pillars of coal, to protect the tramway behind the men who are forming a fresh set of pillars and a new way. Immediately that the men have begun to form the second row of pillars, another body of men must continue cutting away the outer row, so as always to keep one complete row of pillars between the tramway and the falling of the roof behind. The air would thus sweep past the men forming the pillars, and those who are cutting them away and letting the roof fall in. By these means there never would be occasion to open into old workings, since the mine would be cleared as the work goes on; besides, there would never be any danger from the men accidentally opening into the old works, so frequently the cause of explosions, as the brick-work, when met with, would warn them of the contiguity of an exhausted mine.

"3d. For the purpose of ventilating, I recommend the air to be drawn off by means of a circular fan; and by increasing its size or velocity, any requisite quantity of air may be drawn off without danger from explosion, even if there were foul gas. My plan is simply to construct a chamber over the shaft, with a room above for the ventilator to be placed in; the lower room should have a swing-door to convey the coal through, thus entirely obviating an important objection to the present mode of placing the ventilator at the top, by which the shaft is closed and rendered useless; whereas, by my plan, the same shaft will serve to draw off the foul air and to convey the coal. I have now only to point out how my new system of ventilation may be applied to old works with perfect safety. Supposing a large portion of a mine to have been left unworked, the two shafts that have been already used for the old mine should be taken, and a ventilator placed at the head of the upshaft. Any of the old lines that might suit best, should then be taken for the purpose of forming a gallery round the whole works, using the precaution of building up the ends of the openings as they are met with. In order to ventilate the gallery and goafs, and to draw off the foul air from the old works within the inclosure, there should be a space built off, as described above [*See Plan.*] When it becomes necessary to advance into the old works, the first stoppings must be removed; previous to which, however, the whole of the ventilating power should be applied to that part which ventilates the entire inner space of the old works; the stoppings may then be safely opened, and others placed three pillars in advance of those taken away, and the ventilator applied as before; and so on till the mine is completely cleared."

3992. Have you considered in your plan how an objection which might be taken to the introduction of brick-work of so slight a description, and so ill calculated to bear the pressure of the superincumbent mass, might be met?—Yes; provided the roof is not sound enough for brick to support it, I should propose to leave a sufficient body of coal, forming two ways instead of one, the one to go and the other to return; the returning one would draw off the foul air as far as the men have worked, and the advancing one the fresh air.

3993. By whatever means two distinct courses could be obtained in the opening out of the mine, the simplest and that best calculated to insure its being constantly in a state of repair or open, would satisfy your ideas?—Certainly.

3994. Do you attach any more value to the form of a parallelogram or a square than merely as preserving uniformity and regularity, on considering such cases as where two hatches might render the formation of a perfect flabellation impracticable?—I am not at all bound to any form; in fact, it would do with a circle, but not so well, because it could not be lighted so well, but the ventilation would go on just the same, as the body of the coal must not be entered any more for a circle than for any other form, but the square is not essential.

3995. The leading feature of this proposition appears to be, that no portion of any

any given field of coal is to be wrought until effectual means have been taken for the thorough ventilation of the whole piece so taken in the course of the excavation?—That is perfectly correct.

3996. And hence, if any objection arises on the ground of delay, that must be met by a willingness to secure a smaller section of coal in the first instance?—Yes; you may work this principle upon any extent. In an area 600 yards square you have only, at the utmost extent, 1,200 yards to go for the ventilation; whereas, a mine on the principle at present in use requires 27 miles of circulating channels for the air to run; therefore it presents a great deal more surface, and of course that surface is yielding gas; it presents 27 miles of surface on each side, instead of 1,200 yards. I have by my principle little more than 44 yards to one mile of the old principle for the air to run, leaving no recesses to hold the gas; there is not a recess there on my principle, nor ought there to be any.

3997. As in the course of the evidence it appears that experience has proved the system of taking hold of small portions of the field, rather than going to any great extent, is preferable, particularly in some of the midland counties, would you not consider that in those districts the plan might be most easily tried, without interfering with prejudice?—Yes; you might try it upon an old mine without any expense, merely building up the openings and taking the old shafts and any of the roads that might suit. They might try the experiment in the Wallsend colliery, and in many parts to great advantage, and be at little additional expense except the building up the openings.

3998. Have you adopted the mechanical operation of a revolving fan in preference to the furnace now in use?—Yes.

3999. Why?—The reason why I have adopted that in preference to the furnace is this, according to the evidence given by Mr. Buddle and various others, explosions have taken place in consequence of the gas coming in contact with the fire, and the difficulty of getting rid of that has already appeared on Mr. Buddle's evidence. You are obliged to use various apparatus, otherwise the men would not dare to go down. Now here, the moment an explosion takes place, which I am bold to say will never be, the ventilation can be increased as required, and the ventilation is most wanted at the time an explosion takes place.

4000. Are you aware whether your plan of ventilating by exhausting the mines through the agency of a rapid revolutionary fan has ever been tried?—I am aware now, but not when I first projected my plan; I heard they used a fan with the hand; Mr. Smith told me so when I showed him this; and I think the witness, Mr. Roberts, also stated it, but it was to blow the air down; they used it the wrong way, as it would have had double the effect and have been perfectly easy to draw off the air; but in attempting to force it through, it cannot be forced in sufficient quantities to ventilate at all. It would draw for 100 miles by suction and receive no obstruction whatever; but by forcing it, the obstruction must obviously be great.

4001. But has it ever been done with the aid of the powerful agency of a steam-engine?—Not that I know of; I never heard of it.

4002. Your theory is, it might be constructed of such a size and cause a revolution with such velocity as to produce ventilation, on the principle of exhaustion, to an indefinite extent?—Yes; but as relates to my plan, the air-courses being so short, comparatively little ventilation is necessary; whilst by the old principle a ventilation of many miles is required.

4003. On your plan, although the air-coursing would be materially shortened, and the draught in consequence accelerated, and the air in circulation continued purer, yet you appear to meditate the necessity of sacrificing, under certain circumstances, one or more rows of pillars from place to place?—I have not hesitated to do so, because a practical gentleman told me that the goafs were the most difficult things which they have to deal with, and unless I could ventilate those goafs, I could do nothing further. That compelled me to think of this mode of doing it. I found it necessary to sacrifice a small portion of coal for the sake of saving human life, and that of course is a great object; it is *the* object, in fact. I do it both in the old mine and in the new.

4004. By this means you propose in succession entirely to abandon the goaf, taking care to provide for it a separate and distinct ventilation of the gas which may flow from the goaf?—Yes; the air which flows from that goaf is supposed to be very foul, and I separate it entirely; it is drawn by the same fan that draws the other, and requires no second.

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4005. By this means also you propose by forming the whole of the abandoned workings into one waste or goaf, to avoid the creation of those partial gasometers which occur in the present mode of working, and which can only be imperfectly secured by stoppings?—Yes.

4006. Has an inspection of the plans already produced before this Committee led you to contemplate greater danger as arising from those magazines on the present system of working?—Yes, decidedly so; I consider the danger lies there entirely, in not only the goaf behind the works, but the goafs which are in the works while they are working them; I consider those the most dangerous of all, because they are very large and liable to be put in circulation while the work is going on. The stronger the circulation the worse it is for them. If any of the stoppings get damaged, they sweep the foul air all out into the passages, and explosions are liable on the instant; when one explosion takes place, it blows out other stoppings, and sets other gas, which is in those parts, in motion, and then, as one of the gentlemen said in his evidence, "the whole mine might have been blown up at the same time," the whole of the works of that great mine at Wallsend.

4007. In the diagrams that you have laid before the Committee, you have presented a copy of a portion of Jarrow's colliery; the shaded parts are those to which you have just alluded, as being so dangerous when abandoned in pursuit of works in other parts of the mine?—Yes, the bearings are taken away to be used where the men are working.

4008. Have you seen a plan similar to the plan which you produce, which was laid before a public society in Newcastle by Mr. Buddle?—Yes.

4009. Is this a copy of that plan?—This is a copy of the plan of the Jarrow colliery, as presented by Mr. Buddle.

4010. On that plan the points where the men were stationed or where they were found dead are designated?—Yes.

4011. Do your observations confirm your theory, as to the great danger which prevails at such points in case of explosion?—Those points where the shaded part is shown are the dangerous parts: those points where the roman capitals appear on the plan are the points at which the men were found destroyed. The Committee will see that there are certain stoppings which are marked with the letter *a*, (a small *a*) each of those stoppings and doors were blown away when the explosion took place; and the figures placed near to the roman capitals show the number of people who were killed upon that spot. At letter *k* twelve men were killed, and a horse; at letter *m* three; and at letter *n* two.

4012. Then if your plan were adopted it would also greatly lessen the number of stoppings, and trap-doors, and other precautions that are now necessary to preserve the air-current?—Yes, and do away with all the danger, inconvenience, and enormous expense attending on trap-doors.

4013. Whilst you recommend this plan, you are quite aware that there may be local circumstances which may prevent its being carried into execution?—Yes.

4014. It is on a general principle upon which you propose it?—I cannot see any position where it cannot be used in principle.

4015. Are you aware that in some coal fields the pressure of water is so very great upon the coal, that you cannot keep a drift of any dimensions open above a few weeks?—I was not aware that such a case as that would occur, but if that is the case, the simpler your works are the better, the less number of lines you have to contend with the better, and you of course can afford to make a much better drainage to one line than to 20.

4016. Are you aware of the fact, that one line after another is abandoned and a fresh one taken, as the expense of keeping up the roof is found to augment?—I think circumstances might compel one upon the spot to adopt various modes according to those circumstances; but when the way is very short, much better work can be afforded.

4017. Would your plan in any way increase the difficulties of working such a mine?—It would not increase the difficulties, but would be very much more easy to work.

4018. Of course under your plan the whole of the water disengaged in the given section of the coal field must be drawn before the coal work could commence?—Yes; whatever water appears is as dangerous as the gas; the pit must be drained of the water, as well as ventilated. [*The Witness handed in his Plans.*]

4019. Is there anything further that you wish to add?—Nothing further; only that

that I should wish to suggest the necessity of taking advantage of Mr. Buddle's principle at Wallsend colliery being lithographed and laid before the public.

Mr. *Thomas William Embleton*, called in; and Examined.

4020. I BELIEVE you are a mineral surveyor and coal-viewer?—Yes.

4021. At present residing in the neighbourhood of Leeds?—At Middleton.

4022. Have you the inspection of the mines belonging to the Rev. Ralph Henry Brambling?—Yes.

4023. What is the depth of your present shaft?—We have three seams at work at present. One lies at the depth of about 40 to 70 yards from the surface; another 38 yards lower, and the deepest at work from 28 to 32 yards deeper.

4024. Making in the whole?—The depth of the under seam would be from 110 to 140 yards.

4025. Do those seams vary materially in the thickness of the bed?—No, very little.

4026. What is the middle thickness of the seam?—The upper seam is about two feet eight; the middle seam from two feet ten to three feet four; and the lower one from four feet six to five feet.

4027. Have you good roofs and thills for those seams?—The thill of the lower seam is very soft, the thills of the upper and middle seams are pretty hard. The roof of all in general is tolerably good.

4028. You are aware that the objects of the inquiry before this Committee are to ascertain the extent and cause of those fatal explosions which have taken place in the mines of Great Britain; are you annoyed in your mining operations by the formation or exuding of carburetted hydrogen in your collieries?—Only in the low seam.

4029. Is it to such an extent as to endanger the safety of the men employed?—Not generally.

4030. Have any fatal accidents occurred while you have had the inspection of those works?—No, none.

4031. Have you had any fires?—There have been slight explosions. A man has occasionally got himself burnt, perhaps two or three in the course of four years.

4032. You state that in those mines only two or three men have sustained any material injury in the space of four years?—Yes.

4033. Are you acquainted with the mines of Rothwell Haigh?—Generally, I am.

4034. Would the description you have given of the safety with which the mines at Middleton might be wrought be a fair specimen of the other mines?—Yes.

4035. Are you acquainted with any of the mines in the neighbourhood of Bradford or Halifax?—No.

4036. Are you aware, from authentic information, whether there is more gas in those mines than in yours, or less?—I believe there is less.

4037. Are you in the habit of making large or small winnings in your field?—Formerly they were in the habit of making small winnings, but now we are making larger winnings.

4038. By your last sinking what quantity of coal in acres did you propose to win?—From 70 to 80 acres.

4039. Do you consider that an extensive winning, as compared with those with which you are acquainted in the north of England, further north?—No, I should consider it a small winning as compared with them.

4040. Then, in point of fact, the extent of the working taken into account and the small quantity of gas which you have to encounter, you find no difficulty in keeping up a good ventilation in the mines in that part of Yorkshire in which you now reside?—No, when proper care is taken there is no difficulty at all in keeping up a good ventilation.

4041. Are you acquainted with the mines in the neighbourhood of Sheffield?—No, I am not.

4042. Are you aware that in a Return made to the Honourable House of Commons by the coroner for the West Riding of Yorkshire, several hundreds of cases of deaths in mines, without specifying the immediate cause, within a limited number of years, is in existence?—No, I am not aware of it.

4043. You have no reason to suppose that there are any what would be considered

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sidered on the banks of the Tyne and Wear very foul mines in the West Riding of Yorkshire?—No, I should consider not.

4044. Is the system of ventilation adopted by yourself or your neighbours in Yorkshire materially different from that in use, under similar circumstances, in Durham and Northumberland?—It is a modification of that system, but much simpler.

4045. Do you think it an improvement upon the system pursued in your country?—The system pursued at Newcastle could not be adopted in Yorkshire, from the method in which the coals are worked.

4046. Is it the nature of the seam that imposes the necessity of altering the mode of working, or is it merely the force of habit and custom?—Chiefly the force of habit.

4047. Do you think the system of getting coal in the neighbourhood of Middleton is superior or inferior to that pursued in Durham and Northumberland?—It is much the same in that respect.

4048. What mines are you acquainted with in Durham and Northumberland?—I am acquainted particularly with Coxlodge and Gosforth collieries, in Northumberland and South Shields, and Heworth collieries, in Durham.

4049. Had the Gosforth winning to the dip of the main dyke been accomplished when you left that part?—Yes it had.

4050. Could you give the Committee any idea of the relative quantities of gas found on the high-side of the dyke and on the dip-side of the bank?—No, I have no means of ascertaining that; the coal on the south side had been worked and abandoned some years previous to the present winning being commenced.

4051. Do you know whether it is anticipated that that dyke would afford the means of conveying off a large portion of the gas to the dip of it?—I suppose it would not have that effect.

4052. You never heard any theory started upon that subject?—No, none at all.

4053. Did you consider Gosforth mine a foul mine when you were in it?—No, I did not consider it a foul mine at that time; it was merely commencing then.

4054. Have there been any accidents in this mine?—At two several times some men were burnt.

4055. Were they severely burnt?—Slightly burnt.

4056. As you have mentioned several foul mines as coming under your notice, had you ever any opportunity of judging of the comparative value of Sir Humphrey Davy's lamp?—I consider it quite safe when it is properly used.

4057. What do you understand by the term "properly used"?—If the lamp be lighted and introduced immediately into an atmosphere of inflammable air, it will explode; but if it be left burning some time before it is introduced, it will not explode.

4058. Do you account for that accident from the agitation of the lamp, or from anything connected with the temperature of the gauze?—It was merely an experiment that I tried; it did not occur in a pit.

4059. How do you account for such a phenomenon?—I suppose that the inflammable atmosphere is attenuated or increased by the heat, and the explosive particles being further removed from each other, are consequently less liable to be ignited; besides, I should imagine that the generation of carbonic acid by the burning of the lamp itself, would impede the transmission of oxygen through the gauze, and also render the chance of an explosion almost impossible.

4060. Would you suppose that it was occasioned by the lamp previously filled with pure atmospheric air becoming suddenly incorporated with such a proportion of hydrogen as to render it peculiarly explosive, and the explosion forcing the flame so ignited, just procured, through the meshes?—I am not aware that it would. I should attribute the phenomenon to the deficiency of carbonic acid, and the coldness of the mixed gases in the interior of the gauze cylinder of the lamp.

4061. Could such a circumstance have taken place practically in the working of a pit?—The lamps are generally lighted some time previous to their being introduced into the works. The men get the lamps at the shaft, and have to travel some distance to their work before they are exposed to any dangerous atmosphere.

4062. Then instead of an immediate explosion, the air is gradually adulterated, and

and no violent sudden explosion takes place?—No, not after the lamps have burnt some time.

4063. Were you ever present when one of Sir Humphrey Davy's lamps exploded?—No.

4064. Do you know of any case?—I have heard that 10 or 12 years ago two men at Middleton colliery lost their lives by entering with Davy-lamps into a very strong current of air, highly impregnated with carburetted hydrogen.

4065. Do you apprehend that I could walk safely with one of Sir Humphrey Davy's lamps hanging on my finger, at my ordinary pace, through an inflammable atmosphere?—Yes.

4066. Have you ever tried it?—Yes, I have.

4067. Had you any good grounds to believe that the atmosphere was at that moment, through which you were passing, in a highly explosive state?—Yes, it was burning in the lamp at the time.

4068. And the flame never passed the gauze?—No.

4069. Have you never noticed the wastemen in the north protecting their lamps in travelling, by covering them with their jackets, or carrying them against their breasts?—Sometimes; it is occasionally done as an extra precaution.

4070. Are the wastemen generally supplied with shields for their lamps?—No, not to my knowledge; they are common lamps, such as that on the table.

4071. Have they any shield similar to the one at the back of that lamp?—No, none that I am aware of; merely the gauze.

4072. Have you seen the wastemen often engaged in traversing the wastes?—Yes, frequently.

4073. When those wastes were very foul?—No, not when they were foul; it is considered not proper to go into them when they are very foul.

4074. But supposing a mine is reported foul, is not the first consideration how the air-course is?—Yes.

4075. Is not that air-course as liable to be stopped by the fall of the superincumbent stratification, as by accident?—Yes, when the roof is unsound, it is liable to be stopped.

4076. Does it not become necessary immediately to clear away that obstruction?—Yes; and introduce fresh air at the same time.

4077. But until the cause of obstruction is ascertained, how will you introduce the air?—The communications are generally short in the pits, so that we can introduce a quantity of fresh air as we proceed, by opening the stoppings.

4078. But there is frequently no communication between the foul-air drift and the free-air course, for a great extent?—It may so happen, sometimes.

4079. What would you consider the ordinary distance that these communications are apart?—The communications with us are generally made from 12 to 15 yards.

4080. Then are there double doors placed at every one of those communications?—No, always a brick stopping, except in the main roads where men pass along; and the doors are used where necessary for ventilation.

4081. Would it not be attended with danger to remove one of those stoppings at the time you knew the air-course was impeded, by admitting the gas into the free-air course where the men were at work?—It would if the gas were admitted in a very considerable quantity, so as to render the mixture of the foul air and fresh inflammable.

4082. Can you ascertain, before you remove the stopping, what the pressure of the gas behind it is?—No.

4083. Will it not exude the moment an orifice is made?—It will, provided there is sufficient pressure.

4084. Do you think a lamp held before a boiler of gas, might be made to explode that gas?—I am not aware of that; I have seen a lamp exposed to a very strong stream of coal-gas experimentally, and it did not explode.

4085. Have you seen the experiment repeated?—Yes.

4086. And it never exploded?—It never exploded.

4087. Then from your own experience, any experiments attended with different results which might be reported to this Committee, would in your opinion be doubtful?—Such cases might occur; I am not aware that they have.

4088. You admit that they may occur?—Yes, they may occur.

4089. Has anything occurred to you in the course of your professional career as a great

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a great improvement on the mode of ventilating mines over any you have ever seen adopted?—No.

4090. Can you give the Committee any idea how they might procure any statistical accounts of the accidents which have occurred in the Yorkshire mines?—I think I could procure them partially from 1825 to the present time. When I was with Mr. Hill of Newcastle, I made out an account every year of the accidents that occurred in Northumberland, Durham, and in all the other collieries in Great Britain, as far as they could be ascertained from the newspapers. Mr. Hill has them now.

4091. Do you think that that list will be found to contain an account of all the accidents, as reported in the newspapers, in Yorkshire, Staffordshire, North and South Wales, and other mining districts, as well as Durham and Northumberland?—I believe so.

[*The Witness was requested to furnish a copy of that document.*]

4092. Does anything occur to you to suggest to this Committee by which the welfare or the personal safety of the mining population of this country, either those immediately under your own inspection, or with whom you have been at any time acquainted, can be served or improved?—No. If any improvement had occurred I should have adopted it immediately.

4093. On reflecting upon what you have known of the care taken in the north of England, are you of opinion that as much attention is paid to the ventilation of the mines as is within the reach of science and mechanical skill?—Yes, quite so.

Robert Grundy, Esq., called in; and Examined.

R. Grundy, Esq.

4094. WHERE do you reside?—I reside at Manchester, at least, near Manchester, at Green Heys.

4095. I believe you are a proprietor of extensive coal works in that neighbourhood?—We (my brothers and self) have two collieries in the neighbourhood of Bolton.

4096. Are those mines what would be considered in mining phraseology dangerous mines?—No, they are not.

4097. Are you never annoyed or interrupted in your works by the effusion of gas?—We are never much annoyed; we have some little of it, but never much to inconvenience us greatly.

4098. Have you ever had any accidents from explosion of gas?—We have had no accident of any great importance for many years.

4099. Do you recollect the date of the last explosion?—No, I do not, for they occur so seldom that we never think of making any particular memorandum about them; and one of my brothers now manages the works, so that I cannot say.

4100. Is it 20 years ago?—No, it is not so much as that, certainly. We have had persons partially burnt, but we never had one, to my knowledge, ever actually killed by explosion.

4101. Are the numbers that are burnt more or less considerable in the course of any one year?—No, there is no certainty at all in regard to that; we find, if anything, there is more danger in close, hot weather.

4102. Looking back to the last five years, how many men or boys do you apprehend may have received serious injury by partial explosions of gas within that period?—I cannot say, but I should think in our immediate district, at least in collieries I am at all acquainted with, probably not a score, and most of them partially burnt.

4103. What would you describe as your immediate district?—I call our district Kersley, Farnworth, Worsley, Bolton, and Little Lever, that is our principal district, at least what I should call so.

4104. Do you include the Ashton and Duckinfield coal field?—No.

4105. Do you include the Oldham mines?—No.

4106. Have you any knowledge of those mines last named?—I have no practical knowledge of the Ashton or the other mines at all, not having been down any of the works.

4107. Do you know the Oldham mines?—I know them only by report; I never was down them.

4108. Do you know the Wigan mines?—I know them only by report; I never was down any of those pits at all.

4109. Have you reason to know whether any of these mines are more liable to be

be affected by the effusion of gas than your own?—I believe they are rather more liable to be affected there than in our district.

4110. Was there not an accident since the commencement of the present year in the neighbourhood of Wigan by which a considerable number of men lost their lives?—I believe there was; I do not know the particulars of it, but there was one said to have taken place.

4111. Do you think such a casualty could occur in your own mines?—No, I think not; we have very little inflammable air with us; very little indeed; in fact we scarce ever use a lamp at all.

4112. Is that the case in the Worsley mines?—Yes; they are, according to report, very safe mines as well as our own.

4113. And the other mines in that neighbourhood as well?—Yes, they are generally very safe mines indeed.

4114. What is the thickness of your mine?—We have one mine about 7 ft. 3 in.; I am speaking of saleable coal; we have another about 3 ft. 4 in. I think, and another about 2 ft. as near as I can recollect.

4115. And what is the rise of coal in the seam?—I suppose about one in seven; it varies a little; I cannot say exactly.

4116. Do they lie one above another?—Our first thickest mine lies, if I mistake not, about 11 yds. above the second thickness of the mine. The 7 ft. mine, or what I have just alluded to, is the first that we come to; the other is about 11 yds. below: and I think the other about 24 yds. below the second, if I mistake not, but I cannot say exactly.

4117. Which is the best coal?—The middle mine is the best house-fire coal. The lower is more used for burning into coke.

4118. What distance from the surface is the first?—At one of our pits it is about 55 yds. to our first mine; but the depths of pits depend principally upon the situation of the surface.

4119. How near the top is it?—Whatever the thickness of the roof or the ground may be at the top, the mine is always on the same level, excepting when it is thrown up or down by a fault.

4120. What is the average depth of any one of your shafts?—I think the deepest we have is about 95 or 100 yds. They are very much deeper on the Ashton and the Oldham side.

4121. In point of fact, you are able to ventilate the whole of the three seams from one shaft?—Yes; but it is better to have two.

4122. What is the greatest length of the air-course?—I cannot exactly say; they differ; it may be perhaps 200 or 300 yds., or very much more. We generally drive up to the boundary the first thing, and, if possible, to the extent of our boundary.

[*The Witness handed in a book containing an account of all the Accidents that have occurred in the neighbourhood of Ashton for some years past.*]

4123. Has not an accident recently occurred in your neighbourhood?—Yes, at Little Lever, at Mr. Fletcher's work; the bed of the river seems to have given way; it had nothing at all to do with damp.

4124. The river broke into the mines?—Yes, so I understand.

4125. How many lives were lost?—I think about 17.

4126. Did that arise from their having worked the coal too near to the river?—I do not suppose they had worked it too near, but I presume there happened to be some fault in the roof, which perhaps could not have been perceived, even if it had been very particularly looked at. It was considered very safe, I believe. I do not believe there was any fault attached to anybody in the matter, as far as I could hear.

4127. Do any of the mines in your colliery come up to the river?—No, none at all.

4128. They do in Clifton?—Yes, they do.

4129. Do you believe that a small work, entitled, "An Address to Coal Miners," printed in the year 1832, and edited by John Howcroft, contains as correct an account as can be obtained of the accidents that have occurred within a limited period in the neighbourhood of Ashton?—Yes, I do.

4130. Are there any other publications of a similar character to which you can refer the Committee?—I am not aware of any other.

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4131. What is the opinion of the coal-owners in your neighbourhood respecting any legislative enactment?—We are decidedly of opinion we do not need any.

4132. Would you be of opinion that the Legislature ought to interfere if 100 or 200 men lost their lives annually in your district?—Yes, I think it ought to be the subject of inquiry; but such a case does not occur with us.

4133. Do you see that very great difficulties must necessarily attend any attempt to legislate in a case where circumstances vary so materially?—There must be great difficulty. A great number of the accidents with us that do occur, the major part of them, are from the carelessness of the men themselves; they are exceedingly careless.

4134. Do the men object to use lamps when you urge it upon them as a case of necessity?—We have very frequently to urge them to use them when we apprehend there is the least danger, and they are very frequently averse to it; they do not like to use them.

4135. What is the general complaint which they allege?—They give very little light; there is an objection to them on that score.

4136. Have you ever tried in your sitting-room the relative quantity of light given by a safety-lamp and a pit candle?—No, never.

4137. Would you suppose that one of those lamps, suitably trimmed, did give much less light than a common pit candle?—Yes, I should think so; so much depends on keeping the lamps clean and in good order.

4138. But if they were kept perfectly clean and in good order, well trimmed, with a large wick and good oil, do you think a common pit candle (32 to the pound) would give more light than one of those lamps?—I should think it would give quite as much; but am not certain.

4139. Have you made an abstract of this, of the number killed by accident and those by fire-damp?—In some cases, I think they are not described; but I see the number compared with the number in the Ashton district, if I mistake not, is something like 50 or 60 to 550 in the Durham district. I was looking it over a few minutes ago, and it struck me that there were about 50 in the neighbourhood of Ashton.

4140. What, from accident?—Yes, from 50 to 60, and the other is about 550.

4141. It is not mentioned how they were killed?—In some it is not.

4142. The majority seems to be more from accidents by falling down the pit, and coals falling upon them, and ropes breaking?—Yes; there are very few indeed from the damp, either in the Ashton district or ours.

Charles J. S. Walker, Esq. called in; and Examined.

C. J. S. Walker, Esq.

4143. WHERE do you reside?—At Longford, near Manchester.

4144. Are you interested in the mining operations in that district?—I am one of the proprietors of the Bradford colliery.

4145. Are the works in that mine occasionally interrupted, or the men in any way disturbed in the course of working, by the influx of gas?—Yes, they have been, but not lately.

4146. What time do you comprehend in the term lately?—I have a statement of the number of accidents that have occurred in our colliery for the last 20 years.

4147. Have you any objection to lay that statement before the Committee?—Not the least. There are four from fire-damp.

[*The same was handed in.*]

4148. The paper you have handed in embraces a period of 20 years; it is mentioned that eight pits have been at work in that time, and the number of accidents terminating fatally, of all descriptions, appears to be 15?—Yes.

4149. Out of what number of men?—I do not know the exact number, but more than 100; from 100 to 200.

4150. About 120?—Yes; I should think there are 150, but I am not quite certain of that.

4151. It appears that but four of the parties have lost their lives by explosion?—Yes.

4152. And since the year 1827 you have had no fatal explosion?—No.

4153. Has your system of ventilation been improved since that date?—Not that I am aware of.

4154. Do you recollect any peculiar circumstance attending upon that accident?—No, I do not.

4155. Were the men instantaneously killed?—I rather think some were and some not.

4156. The case of George Blakemore do you recollect?—No, I do not. But I do know that one was not killed instantaneously, because he was in the infirmary, and he lived nine days, I think.

4157. Were their deaths occasioned by burning, the shock, or the after-damp?—By burning, I think.

4158. Do you use the safety-lamp in any of your mines?—Yes, we do use it occasionally.

4159. Have you any reason to doubt its merit as a protection against explosion?—No, not if it is properly used.

4160. Have you ever seen the flame fill the body of the gauze?—No, I have not. I do not understand it practically myself.

4161. You are not in the habit of descending mines, perhaps?—I have been down two or three times, but not generally.

4162. Are you acquainted with the mines in Derbyshire, or with any gentleman engaged in working those mines?—I am only acquainted with Mr. Boothman.

4163. Will you name his residence?—He lives at Ardwicke, near Manchester.

4164. Has he made to you any statement respecting his collieries?—Yes; I received a letter from him, dated July 18th, from Ardwicke-place, Manchester, which contains the following extract: "I have been engaged in collieries during 35 years, and have never employed less than 50 or 60 men, and have only lost one man in all that time, and that was by a waggon wheel falling down the pit." And I believe many of the accidents that occurred at our collieries arose from the negligence of the workmen.

4165. You are aware that this inquiry is chiefly directed to cases resulting from sudden explosions?—Yes.

4166. Are you one of the gentlemen alluded to who have expressed an apprehension of interference on the part of Government in the mining operations?—I have heard the proprietors say that they do not think there is any necessity for interference in our part of the country.

4167. Did that opinion apply to your part of the country exclusively, or to the trade universally throughout the kingdom?—To our part of the country exclusively, because we do not pretend to know what other parties are doing.

4168. If it should occur to Government, as a wise and expedient measure, to send commissioners to investigate the state of mines, as regards the safety of the workmen, would any objection arise to learned men, unconnected with the trade, being allowed such an inspection, do you conceive?—I should have no objection as a proprietor.

4169. Can you conceive any reasonable grounds for objection?—No.

4170. If you were liable to the accidents which you are aware have occurred in the counties of Durham and Northumberland, would you not think it a subject very deserving the attention of the Legislature?—I should think there ought to be an inquiry.

4171. And how would you propose to issue such an inquiry?—I am not prepared to answer that question.

4172. Supposing while that Committee was sitting, after being informed of loss of life to an immense extent having taken place, 100 men should be added to the list in an instant, do not you think it a subject deserving their most serious investigation?—I think it is.

4173. All you are afraid of is unnecessary interference?—Unnecessary interference.

4174. You admit that it may be necessary in certain cases?—I admit that an inquiry is desirable, and I think there ought to be an inquiry; but whether there ought to be any permanent interference is the question. I also think the old law of the land quite sufficient, and a rigid inquiry by the coroner, when fatal accidents occur, would, in my opinion, be all that is required.

4175. What advantage would you anticipate from an inquiry?—To ascertain the cause of these accidents, and whether there was any probability in future of prevention.

4176. If there appeared a reasonable probability of preventing them, and hundreds of years had elapsed without the coal-owners taking the necessary pre-

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caution, how then would you propose to act?—If they had; but it appears to me that the coal-owners have as much interest in preventing these accidents, and perhaps more than any other person.

4177. You speak of the interest of coal-owners in preventing those accidents; provided the pits could not be worked without running this great risk, do you think it is admissible on the part of the Legislature to allow their being worked?—If there were these accidents in certain collieries to happen very frequently, perhaps it would be necessary. But they could not be worked; it is impossible to work them if accidents were to happen very frequently, such as that one at Newcastle.

4178. Do you know it is only 10 years since a similar accident took place in that pit?—No; I was not aware of that. I have heard that it is very probable it will not be worked again.

4179. You are not aware, perhaps, that it is proposed to re-work it?—No, I am not.

4180. Can you give the Committee any information in furtherance of their inquiry, by which the safety and comfort of the mining population of the country, either in your own district, or in others which you may have happened casually to visit, might be advanced?—No; I could only say that I believe, from what I have heard and what I have seen, that the best method is by keeping up a proper ventilation to prevent those accidents.

4181. How would you propose to do that?—I have not, practically, knowledge enough to answer that question.

Jovis, 30° *die Julii*, 1835.

AT THE LONDON UNIVERSITY.

JOSEPH PEASE, ESQUIRE, IN THE CHAIR.

Mr. *S. J. Fitzgerald*, called in; and Examined.

Mr. *S. J. Fitzgerald.*

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4182. DO you attend here as short-hand writer, to take notes of the Evidence for the House of Commons?—I do.

4183. Have you taken down a list of the different lamps on which experiments are to be made?—Yes, I have.

4184. Will you be so good as to read that list?—No. 1, the common Davy-lamp; No. 2, ditto, with different seams; No. 3, Dr. Clanny's new lamp; No. 4, Stevenson's lamp, with glass; No. 5, ditto, improved construction of lamp, with glass, (Mr. Ayres', Newcastle, lamp); No. 6, Robson's Bolton lamp; No. 7, Refrigerating lamp; No. 8, Dillon's lamp, with a shield of talc surrounding it; No. 9, Upton & Roberts's lamp.

Jonathan Pereira, Esq., called in; and further Examined.

Jonathan Pereira, Esq.

4185. ON your former examination, you were so good as to state to the Committee appointed to conduct the inquiry your views as to the relative safety and value of Sir Humphrey Davy's invention; have you a lamp on that principle before you?—I have.

4186. Will you proceed to illustrate the views you then advanced upon that lamp?—There are three lamps present, which are made on Sir H. Davy's principle; one belonging to me, the second belonging to the Mechanics' Institution, and the third one was brought by the Chairman of your Honourable Committee. I propose, in the first place, to show the experiments mentioned by Sir Humphrey Davy, as demonstrating the security of his lamp, and then to prove that although a lamp may stand these tests, it may, notwithstanding, be insecure. At pages 14 and 15 of his book on Flame, he says, "That in plunging a light surrounded by a cylinder of fine wire gauze into an explosive mixture, I saw the whole cylinder become quietly and gradually filled with flame, the upper part of it soon appeared red hot; yet no explosion was produced." We will, therefore, take a cylinder containing an explosive mixture of atmospheric air and coal gas. If it be objected that coal gas is not identical with the fire-damp of coal mines, I beg to refer the Committee to the statement of Sir Humphrey Davy, at page 15. "Though," says he, "all the specimens of fire-damp which I had examined consisted of carburetted hydrogen, mixed with different small proportions of carbonic acid and common air, yet some phenomena that I observed in the combustion of a blower induced me

me to believe that small quantities of olefiant gas may be sometimes evolved in coal mines with the carburetted hydrogen. I, therefore, resolved to make all lamps safe to the test of the gas produced by the distillation of coal, which, when it has not been exposed to water, always contains olefiant gas." I presume, therefore, I am warranted in using an explosive mixture of coal gas and air. [*The lamp was then immersed in this mixture.*] You will please to observe the flame does not pass through the gauze in this experiment; and, therefore, the lamp has stood this test.

4187. What is the estimated proportion of gas in that mixture?—About one seventh part of coal gas. The second method, mentioned at page 16, of Davy's work, is, to place a lamp in a glass receiver, through which is made to pass a current of explosive mixture of coal gas and air. [*The experiment was tried.*] The lamp stands this test also; the gas burns inside the wire gauze cylinder, but the flame does not extend through it.

4188. From that do you not show that the gas becomes inflamed within the gauze, but no flame passes into the surrounding atmosphere?—Yes.

4189. Do you apprehend that is the experiment by which Sir H. Davy meant to prove, that in practical use in mines, a moderate current of foul air falling on the gauze would not produce explosion?—Yes; but there is a third method which he adopted to prove the security of the lamp. At pages 137 and 138, he says, he held the lamp in a blower in a mine belonging to J. G. Lambton, esq., and he states that the result was, the lamp did not fire the gas till the gauze reached a welding heat, when the iron wire began to burn with sparks, and the explosion then passed. As we have not a mine blower to use, I shall employ, by way of illustration, a jet of coal gas.

4190. Will you state the chemical distinction between the gas you are now about to use and that which you understand is found in the mines of Great Britain?—The gas found in the mines of Great Britain is said to be light carburetted hydrogen, which is composed of six parts, by weight, of carbon, and two parts, by weight, of hydrogen. Coal gas consists principally of this, but contains also other compounds of carbon and hydrogen, the nature of which varies with the temperature to which the coal is exposed, the nature of the coal, &c. In other words, coal gas is a variable mixture of different compounds of carbon and hydrogen, the principal one being the gas found in coal mines.

4191. Do you think the gas that lights our streets is a sufficiently near approximation to prove the experiment you are about to make?—I do; I found my opinion on the statement and practice of Davy. It is evident that he considers coal gas a more delicate test for a lamp than fire-damp; but, as I have already mentioned, he thought it necessary to employ coal gas.

4192. Will not the experiment be a test of mechanical as well as of chemical agency?—Certainly.

4193. Will your experiments illustrate your theory so far as regards mechanical agency?—Certainly. I now hold in my hand Sir H. Davy's lamp. In order to show its insecurity, I purpose subjecting it to the influence of a jet of coal gas until the gauze becomes properly heated for the success of the experiment. It is evident at the present time that the flame does not pass through the wire gauze, [*here the experiment was tried*], because, as I believe, the gauze is not sufficiently hot. In the experiment made by Sir H. Davy, which I have already alluded to, I strongly suspect if he had assisted the passage of the flame by a slight motion to and fro of the lamp, the flame would have passed long before the gauze was heated to whiteness. [*Mr. Pereira having held a lamp for a short time in a jet of coal gas, tried to pass the flame through the gauze by a quick lateral motion of the lamp, but the flame did not pass.*] I attribute the failure of this experiment to the weak supply of gas, owing to the slight pressure at the gas works. I am, however, prepared against this cause of failure, for I have a quantity of coal gas in a gasometer, to which we can apply a strong pressure, but I would prefer firing it from the common gas-pipe, and, therefore, I will try the experiment again. [*The experiment was tried, but the flame did not pass.*]

4194. No explosion has passed in the last experiment?—No.

4195. Do you attribute this to the gauze not being sufficiently heated?—Yes. I find it requires some time to heat the gauze. [*The experiment was tried.*] The flame has now, you observe, passed, but the gauze is not injured. Now that the gauze has become sufficiently heated, the flame will be allowed to pass readily. The experiment succeeds better at night, when there is a better supply of coal gas.

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4196. Do you observe by your eye whether there is an appearance of redness on the gauze?—I cannot observe any appearance of redness; but I do not think the eye would be a good judge under these circumstances, for the gauze might be heated to a dull redness, without being visible, owing to the strong white light of the gas within the cylinder.

4197. Do you not apprehend it to be very important to the miner to know what state the gas is in?—Of course it is, and he would observe, by the enlargement of the flame, where there was danger. [*The experiment was again tried.*] You will please to observe, that the flame has passed a second time through the wire gauze cylinder of the Davy-lamp. Let us now try the experiment with a second Davy-lamp. [*The experiment was tried, and the flame passed.*]

4198. But in case the lamp was placed in a foul mine, and of course surrounded by an explosive atmosphere, would not the gauze heat much more rapidly than under the circumstances of the experiment you are now performing?—Yes; and I therefore propose presently to submit this lamp to the action of a current of explosive gas. [*Mr. Pereira again attempted to pass the flame through the wire gauze, by holding the second Davy-lamp in a jet of coal gas, but the flame did not pass; in a third experiment it did pass.*] The experiment, you will observe, will not invariably succeed, and a man, therefore, may try a lamp two or three times and fancy that it is safe, although it may not be really so; for a lamp that will allow the explosion to pass once only in fifty trials, is insecure. Having now shown on two Davy-lamps that the flame will pass when we subject a lamp to a stream of coal gas, assisted by mechanical agency, I propose to subject the Davy-lamps to another test, namely, to hold them before a jet of explosive gas, composed of coal gas and air. The apparatus before me will enable me to ignite a stream of this mixed gas without the danger of its explosion in the reservoir bladder. The proportions which we will, in the first place, try, are three measures of air to one of coal gas. The bladder containing this mixture I attach to the safety apparatus: I shall call it, by way of distinction, the reservoir bladder. I press on the bladder, and a stream of gas is forced out through this jet pipe. I now apply a lighted taper to the issuing gas, and you will observe a bluish flame is produced; the mixture of air with the coal gas very much diminishing the light evolved by the latter in combustion. I propose then to submit the Davy-lamp to a stream of this gas, and when I observe the wire gauze on the opposite side of the cylinder becomes red hot, I have only to project a little coal gas on it, and the flame immediately passes. [*The experiment was tried, and the flame passed.*]

4199. The Committee observe that the gauze becomes red hot?—Yes.

4200. Will you try the experiment, by forcing the coal gas against the gauze in the red hot state, after having removed the lamp from the jet of mixed gas?—The radiating power of the gauze is so great, that the cylinder cools below redness immediately upon removing the lamp from the influence of the jet of mixed gas. However, I will try the experiment. [*Mr. Pereira held the lamp before a jet of mixed gas, until the wire gauze became red hot, and then quickly removed it to a jet of coal gas about half a yard distant; the coal gas immediately ignited.*] You will observe that the flame has passed.

4201. You have succeeded in lighting the gas at the heated gauze?—Yes. I presume these experiments will be sufficient to prove the insecurity of the Davy-lamp.

4202. Do you not make any allowance for the very rare cases in which the lamp can be tested in practice in the way you have now tested it; I mean in moving it forcibly through the atmosphere, dispersing the whole of the carbonic acid gas, and bringing it back to the jet, with an explosive mixture filling the gauze?—I apprehend the question to be, how far my experiment is analogous to the circumstances met with in coal mines. In coal mines the miner's lamp is sometimes exposed to immense quantities of gas, and to powerful blowers. I presume, therefore, if I can cause the flame to pass through the wire gauze cylinder by means of a small jet of gas like this, that the passage of the flame will take place more readily in coal mines. If the miner move his lamp, the danger is increased. A current or motion of the gas by a fall of water may endanger the lamp.

4203. Can you explode the Davy-lamp by a mixture of carburetted hydrogen and atmospheric air, by merely plunging a lamp suddenly from the common atmosphere into such mixture?—I have never been able to do it; but the quantity of mixed gas which I have experimented with is so small compared with that

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found in mines, that I can readily believe explosions may occur in mines which we cannot produce on the small scale. I have frequently tried the experiment, but never produced the passage of the flame, owing in part, as I conceive, to the presence of the carbonic acid, which is produced by the combustion of the gas within the cylinder. However, there is a gentleman in this room who asserts that he can pass the flame under these circumstances. If you please, therefore, we will try the experiment. We have here an explosive mixture of six parts atmospheric air, and one part coal gas; and I propose, therefore, to fill this large cylindrical vessel with it, and then plunge the lamp in. [*The experiment was tried.*]

4204. The flame has not passed?—No.

4205. Do you apprehend if that lamp had been moved quickly through an atmosphere, combining the proportions you have just exhibited, that any explosion would have taken place?—I think it possible that the flame might pass through the gauze, if the lamp were suddenly introduced into a large accumulation of explosive gas, such as is sometimes met with in coal mines, though the flame will not pass when the lamp is placed in the very small portions of gas which we can subject it to.

4206. Are you not aware that the proportions of air and inflammable gas in mines vary materially, according to the analyses of different individuals?—The following are the results of some analyses of fire-damp made by different chemists:

Dr. Henry's Analysis.

Atmospheric air	63.34
Carbonic acid	1.66
Inflammable gas	35.00
	100.00

Dr. Thomson's Analysis.

Atmospheric air	32.00
Carbonic acid	5.00
Inflammable gas	63.00
	100.00

Sir H. Davy's Analysis.

	Purest.	Most Impure.
Atmospheric air	6.66	41.66
Inflammable gas	93.33	58.33
	99.99	99.99

In some cases azote and carbonic acid were present.

4207. Are these quantities said to have been taken from mines?—Yes, from coal mines.

4208. Is there any means of ascertaining the velocity at which the jet moves?—It could be done, but I have not the means of doing it now.

4209-10. Can you form a rough estimate of it?—No.

4211. Can you suppose, from what you have heard of the state of the mines, the jet of gas having the same velocity there?—I should think a much greater velocity. I have heard of doors being blown down by the sudden escape of gas.

4212. Have you heard of any instance where there was no ignition?—I have heard from Mr. Roberts, that fire-damp has sometimes rushed out (from a sudden fall of coal) with such force that it has blown down doors.

4213. Do you consider that the Davy-lamps you have tried are perfect?—Yes. One of the lamps brought by the Chairman of your Honourable Committee is a new lamp. The wire gauze of which the cylinders are made appears to me, by comparison with some standard gauzes before me, to have at least 900 apertures to the square; and Mr. Roberts, a lampmaker, tells me, that this Davy-lamp which I have

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I have exploded has 1,024 apertures. At pages 44 and 45 of his work on Flame, Sir H. Davy says, a wire gauze having 576 apertures to the square inch is safe, under all circumstances. At page 41, he says, gauze with 625 apertures is safe; and at page 16 he says, one with 784 apertures is safe. I have tried lamps with much finer wire gauze cylinders than those used to-day, and have found the flame readily passes. If two wire gauze cylinders be employed, the experiment occupies a little more time, but the flame readily passes.

4214. Do you consider those experiments to have proved satisfactorily that the Davy-lamps are not what they profess to be, safety lamps?—Yes. I beg to mention, in corroboration of this opinion, that a year or two since I inspected the gas works at Westminster, and the man who was sent round with me showed me the safety-lamps used there, and which were made on Davy's principle. On asking him whether they ever allowed the flame to pass through them, he replied, that twice he had fired jets of gas by them. The circumstances under which this took place he stated to be as follows: he was accustomed to examine the condition of the gasometers every night, and twice in walking round them with a Davy-lamp in his hand he had fired a jet of gas issuing from an aperture in the gasometer. On mentioning the circumstance, he stated he had been blamed for having used an imperfect lamp, but he could not discover any imperfection in it.

4215. Did you examine that lamp?—I did.

4216. Did it appear to you perfect?—Quite perfect.

4217. Was your impression that it must have been furnished to him as one of Davy's safety-lamps, for the purpose of his occupation?—Certainly.

4218. I believe you have a lamp before you, which, in addition to the gauze, has a glass cylinder inside?—Yes, there are several of these on the table. Here is one of Stevenson's lamps, which is marked No. 4.

4219. In what particular does that lamp vary in its construction from the lamp you have just been using? I believe it is specified on the Minutes of the Committee on a former occasion. Is the air admitted from below?—The air seems to be admitted beneath this rim at the lower part. This lamp is locked, and therefore I cannot light the lamp to try it; but here is another, of the same kind and make, which is not locked.

4220. Is the air admitted in precisely the same way?—Yes, as far as I can judge.

4221. I believe that is a lamp, the principle of which was known prior to the invention of Davy's; are you aware whether that is a fact or not?—I am not aware.

4222. Does not the difference consist in the air being admitted from below, and no air being allowed to pass to the gas in consequence of the glass lens inside?—The air is made to pass by some apertures beneath this small brass rim and then through a number of small apertures in a copper or brass plate.

4223. Will you now proceed to try whether you can cause an explosion from that lamp?—I will.

4224. Do you apprehend it is possible to cause an explosion of that lamp in a mixture of atmospheric air and carburetted hydrogen?—I have not yet tried the experiment. Before I proceed to try any of the lamps now present, I beg to state to this Honourable Committee, that I think a higher test of the security of the lamps should be used than merely coal gas and air. The reasons that lead me to this conclusion why a higher test should be taken, are the following: In the first place, a lamp is placed in a more dangerous position in a coal mine, from the presence of immense quantities of fire-damp, and which we cannot imitate here; secondly, the inflammable part of fire-damp may possibly, nay, probably does, vary. Although Henry, Thomson and Davy all agree that the inflammable gas was light carburetted hydrogen, yet certain reasons lead us to suspect there may occasionally be some variation. At page 15 of his work on Flame, Davy states that some phenomena led him to believe olefiant gas was sometimes evolved; and at page 144, he even admits the possibility of hydrogen being present, though he thinks it improbable. Mr. Goldsworthy Gurney, who is now present, tells me that he discovered pure hydrogen in a Welsh coal mine. That there is a considerable variation in the quality of the inflammable gas of coal mines, I have long thought probable, from the statements made by some intelligent practical miners; an opinion which is much strengthened by a knowledge of the variable nature of the gaseous products obtained by the distillation of coal. Taking, therefore, all those circumstances into consideration, I think the most prudent and safe course is to submit the lamps to a much higher test than coal gas and air; but if unfortunately no lamp can be found

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found which will stand this test, we must try them by some lower test. The test I propose is, to expose the lamps to a stream of inflammable gas composed of three or four parts, by measure, of hydrogen gas, and one part, by measure, of coal gas. I think we may fairly presume that a lamp which will stand this test will be safe, under any circumstances, in a coal mine. I do not mean to say that a lamp that will not stand this test is necessarily insecure in a coal mine, but it is better to use a lamp which we know is secure, under all possible circumstances, than one of which we are doubtful. Having made these preliminary remarks, I propose, with the approbation of your Honourable Committee, to subject all the lamps now before me to this test. The first lamp which I will try is Stevenson's. We will expose it to a stream of gas composed of four measures of hydrogen and one of coal gas. [*The experiment was tried; the flame of the lamp was blown out, but no explosion took place.*] You will observe the flame has not passed; but owing to my having propelled the gas into the lamp with too much force, the flame is extinguished; I shall, therefore, repeat the experiment, employing much less force. [*The experiment was repeated on Stevenson's lamp, and the flame passed.*]

4225. You have applied the mixture of which you have just spoken, and the lamp exploded downward; the gas so applied exploded downward?—Yes.

4226. Through the small orifices at the base of the lamp?—Yes; through the apertures by which the atmospheric air is usually admitted to the lamp. I will repeat the experiment. [*The experiment was performed, but the flame was blown out. It was repeated, and the flame instantly passed through the lamp, and lighted the jet of gas outside.*] You will observe, then, that Stevenson's lamp will not stand this test. Let us now see whether the Davy-lamp is more or less secure than Stevenson's. We should, however, expect that as the Davy lamp is insecure even to coal gas, it is still more unsafe to coal gas when mixed with four times its volume of hydrogen. [*The experiment was tried on a Davy-lamp; after three trials the flame passed through the wire gauze cylinder.*] You will observe I had more trouble to pass the flame through Davy's than through Stevenson's lamp. The next lamp which I will examine is that made by Mr. Dillon, and which is marked No. 8. It has much the same structure as the Davy-lamp, but the cylinder is longer; there are three wicks, and it is covered externally by a shield of mica, as recommended by Davy at page 136 of his work on Flame. [*The experiment was tried, and the flame instantly passed.*] No sooner was the stream of gas (hydrogen and coal gas) thrown on the gauze, than the flame passed through.

4227. Of course if the jet came in the direction of the shield, it could have no effect?—No. But as the jet of gas which I employ is very small in comparison with some blowers in coal mines, I therefore direct it a little upwards; for when the lamp is exposed to a large blower, some of the gas must pass up the cylinder, by the current generated by the combustion in the lamp. [*The experiment was repeated.*] The flame has passed a second time.

4228. Have you tested all the lamps?—No; I have only tried the lamps of Davy, Stevenson and Dillon.

4229. Proceed to test all the lamps with the high test?—Here is a lamp marked No. 7.

4230. It is a mixture of Stevenson's and Davy's principle, improved by Wood of Killingworth. Is that lamp known by the name of the Refrigerating Lamp?—Yes.

4231. Is not the upper chamber surrounded by water, to prevent the heated gas passing off at the top of the lamp?—I have never examined it before, but I presume this cavity is to hold water. I am sure that the flame will instantly pass, hough I have never tried the experiment.

4232. You are aware that the water in the upper part of the lamp will prevent the passage of the flame there?—Yes; but there is lower gauze which is not protected by water. This is the most vulnerable part of the lamp, and therefore the one which I shall subject to the influence of the stream of gas.

4233. It is not intended to stand against the experiments you are about to perform, but merely as a protection to the upper part of the lamp?—It should be a protection to the lower part, otherwise the lamp is not safe. As the refrigerating lamp is not yet prepared for the experiment, we will try Mr. Robson's lamp, marked No. 6. This lamp, also, I have never tried before. [*The experiment was tried.*] The flame passes instantly downward. Mr. Robson's lamp explodes with the gas, and is therefore insecure.

Dr. *Clanny*, Examined.

Dr. *Clanny*.

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4234. HAVE you any objection, or do you see any reason, why your lamp, which is known as your improved lamp, should be subjected to the experiment of the highest test which has been already tried on other lamps?—It has been submitted to a current of inflammable air, both in coal mines and also in my laboratory.

4235. Do you, Dr. Clanny, apprehend, from what you have seen in the mines yourself, that you would be likely in the mines of Durham to meet with a gas which would constitute so high a test as what we are now applying?—It is a subject which I have not heretofore entertained. But if this Honourable Committee requires it, I will go into the most inflammable mines in the counties of Durham or Northumberland at any future day.

4236. But, Dr. Clanny, if your lamp should explode with the mixture which has been produced, you would not at all attempt to deny that it would be exceedingly dangerous to do so; if you could suppose a similar combination existing in mines, subject to an equal mechanical pressure?—The principle of this is simply that the moment the inflammable air is admitted to it, the shield descends; the piece of wire is fused, and the shield descends, so as to isolate it in respect of the surrounding atmosphere.

4237. Are you not speaking of the combinations which you know to exist in the mines around your residence?—Precisely.

4238. You do not allude to the combination of gas now produced to the Committee?—I do not; upon that point I have not considered the subject; nor do I consider at all whether it would be proper to try it with pure hydrogen, as we call it; in this instance I have no objection to the trial.

4239. While you admit the fairness of the experiment, your conviction is that it is not an experiment which can be practically performed in mines?—I am not aware that there is any pure hydrogen in mines; I never found any pure hydrogen in mines; but I have been impressed with the idea that there is olefiant gas in mines, but to what extent I cannot say.

Mr. *Pereira*'s Examination resumed.

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4240. WHAT lamp are you going to make the experiment on now?—I will now take the water lamp, or the refrigerating lamp. [*The experiment was then made.*] The flame passes directly. [*The experiment was repeated.*] It has again passed it, but not so easily as the first time, probably because there is a little carbonic acid in the cylinder. [*The experiment was again tried.*] Again you observe the passage of the flame through the apertures of the lower part of the lamp.

4241. Have you got the lamp before you on the principle of Dr. Clanny?—Yes.

4242. Are you aware of the principle on which that lamp is proposed to act; the external shield being supported by a small wire across the gauze, immediately the wire is fused by the burning of the explosive mixture in the inside, the shield will descend?—Yes, and upon that principle it is called a safety-lamp; I had heard of it, but never saw it till to-day.

4243. Will you please to proceed to place the lamp burning (Dr. Clanny's) in such a composition as you presume, from what you have heard, is ordinarily found in mines in an explosive state?—With the permission of this Committee, I will first subject this lamp to the same mixture which I have tried on the other lamps, namely, four measures hydrogen and one coal gas. [*The experiment was tried; the flame instantly passed.*]

4244. Can you plunge Dr. Clanny's lamp into a receiver full of gas, so as to support combustion for a few seconds without firing the gas?—I do not doubt it; Davy's lamp will do that.

4245. What the Committee wish to know is, whether the mechanical contrivance of the shield will act?—[*Dr. Clanny, on examining his lamp, objected to any further experiments being performed on it, on the ground that the lamp had not been properly prepared for the experiment.*]

Dr. *Clanny* Re-examined.

Dr. *Clanny*.

4246. ARE the Committee to understand that you object to any experiments being proceeded with on the present occasion as to your lamp, owing to your lamp not being properly trimmed, or satisfactorily prepared for the experiment?—Certainly.

Mr. *Pereira*'s Examination resumed.

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4247. WILL you now proceed with the high test to try Messrs. Upton & Roberts's lamp?—I will. [*The experiment was tried.*] The flame does not pass in this position, but I will try the lamp in another. I beg to state, that if the Committee meet again, I shall be happy to make any experiments on Dr. Clanny's lamp at such time they may think proper to appoint. [*The experiment was again tried on Messrs. Upton & Roberts's lamp.*] I have again exposed this lamp to a jet of hydrogen and coal gas, but the flame has not passed.

4248. Is not the gas in the bladder nearly exhausted from the effect of the experiments previously made?—There is quite sufficient left. [*The experiment was repeated.*] The flame of the lamp is now blown out, in consequence of my propelling the gas into the lamp with violence. [*The lamp having been re-lighted, was again exposed to the jet of four measures of hydrogen and one of coal gas, but the flame did not pass*]. To prove that the gas I am now using is a high test, let us take Stevenson's lamp and hold it in the jet of gas. [*The experiment was tried.*] You observe the flame instantly passes; but when I apply the same gas to Upton & Roberts's lamp, slight detonations occur within the lamp, but the flame does not pass; and if we now increase the force with which the gas is propelled in, the lamp is extinguished. [*Experiment performed.*]

4249. What would be the consequence provided the whole body of the lamp was filled with the same gas; would it explode at the top?—This lamp is so constructed that it cannot fill with inflammable gas.

4250. Do you mean to say it would explode before it got fully charged?—Certainly; the gas would burn as it passed into the lamp, and the supply being limited, the wire gauze cannot be filled with flame.

4251. Is there a double wire gauze at the bottom of the lamp, to prevent the passage of the flame?—Yes.

4252. Can you immerse that lamp in a volume of mixed gas, or coal gas and air?—Yes; one part of coal gas, and three parts of air is the mixture which I am now about to employ.

4253. Will you immerse Messrs. Upton & Roberts's lamp slowly in that mixture?—[*The experiment was tried.*]—The lamp is extinguished, but the flame has not passed. I will now use a more explosive mixture, namely, six of air and one of coal gas.

4254. Let the lamp be slowly immersed in that mixture. [*The experiment was tried, and it did not explode.*]

4255. Have you ever tried what the result would be in case a lamp, with the gauze perfectly cold, was placed in an explosive mixture?—The experiment cannot be made with a cylinder quite cold; for in the act of putting on the cylinder after lighting the lamp, the gauze becomes slightly warmed. I have performed the experiment as quickly as I could, and with a wire gauze cylinder as cold as we could obtain it, but I have never made the flame pass by immersing the Davy or Upton & Roberts's lamp in any mixture of coal gas and air. I have tried the experiment frequently, and have considered it with a good deal of attention, understanding an opposite opinion was entertained by Mr. Dillon. I believe that the colder the wire gauze, the safer the lamp; whereas Mr. Dillon thinks the safety of the lamp consists in the cylinder being hot. Every experiment that I have made is against his opinion.

Mr. *Dillon* Examined.

Mr. *Dillon.*

4256. HAVE you performed the experiment which has just been named by Mr. Pereira?—Yes, I have.

4257. What was the result?—An explosion from the inside of the lamp, if the lamp was cold; but if it is allowed to burn for a short time, the caloric in the meshes of the wire gauze prevents the explosion from extending to the outside of the lamp.

Mr. *Pereira*'s Examination resumed.

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4258. DOES that agree with your theory, Mr. Pereira?—No. I should like to see Mr. Dillon perform the experiment, for I have never been able to get the result stated.

Mr. *Dillon* Re-examined.

Mr. *Dillon*.

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4259. DO you object to try the experiment in the presence of the Committee?—No.

4260. Do you attach any importance to the precise mixture of gases?—No. I propose to try it with four parts of air and one of coal gas. For the purpose of establishing my theory, the gas which will most easily explode should be tried. I have frequently done it with hydrogen, which establishes the theory; the explosion takes place outside and inside; if the lamp is hot, the explosion takes place inside. Mr. Pereira may try the experiment before the Committee with hydrogen gas, and it will establish the principle I have laid down.

4261. Have you any objection to repeat the experiment by which you stated you procured the explosion by immersion of the lamp, as cold as it can be, in the proportion of gas already named; namely, four to one?—Yes, I will; but the lamp is not perfectly cold. I wish you would try the experiment upon hydrogen, which will establish the theory.

Mr. *Pereira*'s Examination resumed.

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4262. MR. PEREIRA, the way the Committee understand Mr. Dillon wishes you to proceed is, that the instant the lamp is lighted you should secure the gauze on the lamp and then immerse it in the gas with as little delay as possible. [*The experiment was performed on a lamp belonging to Dr. Turner, which had not previously been lighted; the explosion did not take place.*]

4263. Do you propose to make any other experiments on Upton & Roberts's lamp?—There is one other gas that is still more severe, oxygen and hydrogen, but it is not likely to be met with in mines.

4264. Could you immerse Upton & Roberts's lamp in pure hydrogen?—It will go out in pure hydrogen, from the want of oxygen. I will submit the lamp to four parts of air and one of hydrogen gas, without any coal gas. [*The experiment was tried.*] It will not explode.

4265. What proportions are you now about to use?—About one-third hydrogen and two-thirds atmospheric air. [*The experiment was tried and the lamp was immediately extinguished.*]

4266. Then is the result of your experiments that you cannot assume any contingency in mines in which Upton & Roberts's lamp would be liable to explosion?—As long as the lamp is a perfect lamp, (that is, uninjured in its parts,) I believe it to be quite safe.

4267. Of course the safety must entirely depend on the glass being unbroken?—Yes.

4268. If the glass break, it becomes really a Davy-lamp?—Yes.

Mr. *Dillon* Re-examined.

Mr. *Dillon*.

4269. THE lamp which you have produced, you consider improved to the extent to which the shield operates with respect to the current coming in at the shield?—Yes, I do; I consider that in any coal mine my lamp is a perfect security, the shield of talc is a perfect security.

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[Fourth Examination.]—Explosion at Row Pit Harraton, and 38 lives lost, by the wilfulness of one man unscrewing his Davy, 2955–2957——Manner in which the strength and velocity of the air current is ascertained, 2959–2963——Manner in which the air coursing is increased when necessary, 2964, 2965——Less difficult in ascertaining the admixture of foul air since the introduction of the Davy lamp, 2966——Advantage of having two separate air-courses without communication, 2967–2972——Number of cubic feet of air per minute in the Wallsend mine previous to the accident, 2973——Cubic feet of air per minute in the Hutton seam at Pensher colliery, near Houghton-le-Spring, 2974–2981.

The chief cause of accidents will remain unabated, unless some means can be devised for dislodging the gas during pillar working, 2982——Difficulty of ascertaining the quantity of cubic air emitted from a pit per minute, 2983——Impracticability of letting in a portion of the mine in the Bensham seam having air-courses so as to intersect the goaf, 2984–2986——Difficulty of applying on the instant a vessel of mixed oxygen and atmospheric air to prevent suffocation, 2987–2993——Number of lives saved at the Jarrow colliery, by the presence of mind of the under-viewer, in throwing open the main doors after the pit had fired at the furnace, 2995, 2996——Six men killed at the Burdon mine colliery by the breaking of a rope, 2997–3003——Explosions, inundations, &c., which have taken place in the coal mines of Northumberland and Durham, extracted from Mr. Syke's local records of those counties, and corrected by J. Buddle, Esq., 3003.

Buddle, Mr. His pamphlet was a very valuable addition both to miners and to science, *Wilkinson* 285.

Burdon Mine. Six men killed at the Burdon mine colliery by the breaking of a rope, *Buddle* 2997–3003.

C.

Candles. Candles are not allowed to be used in some pits; in working old pillars they cannot be done without, *Winship* 485–494——Extent to which the use of candles are necessary in mines, lamps are not a sufficiently delicate test to tell the existence of inflammable air, *Wood* 989–996——Cases in which the viewers would be justified in allowing candles to be used, *Wood* 1084——It is justifiable to work a mine with candles, unless the workings contain inflammable air, *Wood* 1089, 1090——Necessity of candles being used in cases where it is necessary to use gunpowder instead of wedges, *Wood* 1096–1098——Instance at Killingworth of lamps being abandoned for candles, for blasting of mines, *Wood* 1099——Nature of accidents in Ashton mine from candles, which caused the use of the lamp, *Garforth* 3641–3645——Disadvantage of men sometimes using a lamp and sometimes a candle in the same part of the mine, *Upton* 1950–1953——Use of candles is a protection, as it keeps the men on the alert, *Buddle* 2071–2073.

See also *Danger. Davy Lamp.*

Cannell Coal. Contains very few pores, and does not evolve much gas, *Wood* 842, *Garforth* 3741.

Cape Breton. Nature of the mines therein, *Smith* 3808——Rise and fall of the stratification in the mines therein, *Smith* 3823.——*See* also *Nova Scotia.*

Carbonic Acid Gas. Circumstances under which carbonic acid gas is met with in mines, effects on the health of the miners, manner it is indicated, *Wood* 860–871——The only mode of expelling carbonic acid gas is by ventilation, or by mixing atmospheric air with it, *Wood* 875——Inhalation thereof acts as poison, *Fife* 1433——Nature of carbonic acid gas, *Fife* 1444–1447——Instance of a man killed while going down a shaft, in consequence of inhaling carbonic acid gas, *Stephenson* 1848–1852——One inspiration of carbonic acid gas would not be sufficient to destroy life, *Birkbeck* 3934——Difference in the post mortem appearance of a subject whose death had been occasioned by carbonic acid gas and sulphuretted hydrogen gas, *Birkbeck* 3936–3939——Most of the accidents from carbonic acid gas occur in the mines which do not abound in fiery gas, *Buddle* 2506——Greater difficulty of removing carbonic acid gas than inflammable air, *Buddle* 2497–2501.——*See* also *Explosions. Inflammable Air. Old Workings.*

Carburetted Hydrogen. Is the fire damp of coal mines, *Wood* 857——Nature of carburetted hydrogen and carbonic acid gas, *Fife* 1444–1447——No chemical process would be effectual in neutralizing carburetted hydrogen; complete ventilation and the safety lamp are the best to be relied on, *Fife* 1454–1456, *Birkbeck* 3919——Mode of ventilating mines cannot be improved without a plan of condensing gas by chemical process, *Forrester* 2822, 2823——Its presence is indicated by the show upon the candle, though that test is not so much attended to as previously to the introduction of the Davy lamp, *Buddle* 2502——Where there is no dislocation of strata there can be no confined hydrogen, *Ryan* 2831——Extent of admixture of atmospheric air necessary to reduce carburetted hydrogen below the explosive point, *Ryan* 2937——Workmen not so much interrupted now as formerly from the effusion of carburetted hydrogen gas, *Smith* 3016, 3017——Proposition for the combustion of carburetted hydrogen, by an aggregation of safety lamps from the roof, *Murray* 3260. 3266.

See also *Air. Bituminous Coal. Davy Lamp. Explosive Mixture. Red and White Heat.*

Carelessness. See *Accidents. Davy Lamp.*

Carron Iron-works. Experiment made at the Carron iron-works, by endeavouring to force air through pipes between one of the furnaces and the other, and reason it proved ineffectual, *Wood* 934.

Carlisle, Lord. His mines, near Brampton, are not fiery, *Stephenson* 1746, 1747.

Carriages. Employment of carriages in the mines in the south for bringing up the waggon which carries the quantity of coal, would do for a very small quantity, but a sufficient quantity of horses and men could not be employed without having a variety of roads, *Stephenson* 1840, 1841.

Casualties. There are not more casualties attending the Cornish miner's life than those of the surrounding population, *Taylor* 276——Nature of those to which operative miners are exposed, *Taylor* 122——Are greater in the coal mines in the north than in the copper mines in Cornwall, *Taylor* 277, 278——No lives have been lost in the mine under witness's management; the system is sufficient to prevent loss of life with proper care, *Smith* 3035–3037. 3045——Greater loss of life has occurred since the introduction of the Davy lamp, but it is in consequence of the risk being greater, *Taylor* 257, *Clanny* 397–403, *Buddle* 2392, 2393.

See also *Davy Lamp. Newbottle Colliery. Newcastle-upon-Tyne.*

Cayley, Sir *George.* Used the principle of reflection to throw day-light to some men who were working a deep well; it had a beautiful effect, and answered the purpose perfectly, *Gurney* 86.

Centrical Fire. Arguments of scientific men as to the existence of a centrical fire from the increase of heat according to depth, *Buddle* 2321.

Chapman, Messrs. See *Maps.*

Charles Pit, at Lumley. Accident there in 1824, and whether from the use of candles, *Winship* 464–472.

Charter-masters. Mode of letting mines to charter-masters; they do not unnecessarily run their men into danger, *Smith* 3098–3104——If the charter-masters thought they should gain by an improved system of working mines they would adopt it, *Smith* 3169–3171.

Chemical Process. See *Carburetted Hydrogen.*

Children. Number of children employed, number of hours they work, and ages at which they are employed, *Winship* 577–592——Boys are employed to attend to the doors, on account of its being less expensive; they generally attend to their duty, *Wood* 1122–1126. 1131–1136——The number of persons continually passing and repassing keeps the children at the trap-doors attentive to their duties, *Johnson* 1371–1373——Minimum age at which children should attend trap-doors should be fixed, *Fife* 1479–1482——Early ages at which children are employed at the trap-doors for the purposes of ventilation in some cases without harm, but in dangerous situations very improper, *Stephenson* 1611–1620.

Chloride of Lime. Experiments by Major Emmett, of the Royal Engineers, showing that chloride of lime does not destroy the inflammable power of gas, as stated by Dr. Thompson, *Buddle* 2496——Advantages that would be derived from the use of chloride of lime in mines, *Murray* 3328. 3333. 3337——Advantages of, for neutralizing the effect of carburetted hydrogen, but which, from the extent of mines in England, could not be adopted, *Pereira* 3968, 3969.

Choke-damp. Is not very prevalent in the Cornish mines, *Taylor* 266——Proportion of men destroyed by the choke-damp after explosion is as three to one over those who are actually burnt, *Elliott* 684, 685. 692——Principle on which the choke-damp might be got rid of, *Murray* 3329–3332.——*See* also *Quick Lime.*

Church, Mr. *Russell.* Accident at Mr. Russell Church's pit, and loss of life by choke-damp, *Elliott* 675–683.

Clanny, William Reid, M.D. (Analysis of his Evidence.)—Explosions on the Wear and Tyne coal-field, about the year 1810, first called witness's attention to the subject, 321–327——Dr. Gray considered the production of Sir Humphrey Davy's lamp a sufficient reason for putting an end to the proceedings of the society for preventing accidents in mines, but the other members of the society did not so consider it, 328–330——Period of the introduction of witness's lamp, and mines in which it was used before Sir Humphrey Davy's lamp appeared, 332–335——Experiments by Sir Humphrey Davy on witness's lamp, and subsequent introduction of his own, 336–340——Circumstances which show the Davy lamp not to be altogether safe; accidents that have happened where it has been in use, 341–352——Witness's improvements upon Sir Humphrey Davy's lamp, and certificates of the utility of them, 353–358——The chief causes of accidents are from unbroken fields of coal and from former wastes, 359——The finer the coal, and the deeper the mine, the more readily will fire-damp occur, 360, 361——With one of his own lamps witness would willingly descend to the most dangerous mine in the two northern counties, at any time, and under any circumstances, 362.

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Precautions that might be taken to prevent accidents in ascending and descending, 375, 376——Comforts of the miners much greater since the Act abolishing the truck system passed, 377–379——Collieries that are favourable to the use of witness's lamp, 382–385——Necessity for the wire-gauze used in lamps being made more perfect than it is, 386–393——Duties of viewers and waste-men as regards the safety of the men, 394–396——The number of deaths has been doubled in ten years since the introduction of the Davy lamp, in consequence of men working in more dangerous places than formerly, 397–403.

[Second Examination.]—Submission to descend the most inflammable mines in Durham or Northumberland with witness's lamp, and doubts as to the experiment in the laboratory, 4234–4239——Refusal to allow his lamp to stand the test of further experiments, 4245, 4246.

Clanny's Lamp. Opinion that Sir Humphrey Davy derived great advantage from Dr. Clanny's lamps, *Wilkinson* 285——It takes the priority; Dr. Clanny has been the inventor of several, and has been an indefatigable labourer, but has received no reward, *Wilkinson* 285——Period of its introduction, and mines in which it was used before Sir Humphrey Davy's lamp appeared, *Clanny* 332–335——Experiments thereon by Sir Humphrey Davy, and subsequent introduction of his own, *Clanny* 336–340——With one of his own lamps witness would willingly descend to the most dangerous mine in the two northern counties, at any time, and under any circumstances, *Clanny* 362. 4234–4239——Power of the miner to recede from danger when he is using witness's improved lamp, *Clanny* 372–374.

Collieries that are favourable to the use of witness's lamp, *Clanny* 382–385——It is an improvement upon the Davy lamp, *Elliott* 814–817. 821–828——Witness's improvements upon Sir Humphrey Davy's lamp, and certificates of the utility of them, *Clanny* 353–358——Cases in which Clanny's lamp may be useful, and manner of its operation, *Wood* 1029–1046——Refusal to allow the lamp to stand the test of further experiments, *Clanny* 4245, 4246——Doubts as to the experiments on witness's lamp in the laboratory, *Clanny* 4234–4239——Experiment on Dr. Clanny's lamp, through which the flame passed, *Pereira* 4241–4245——It is very ingenious; the only difficulty is in getting the miner to manage it, *Stephenson* 1559–1561——Dr. Clanny was the first person that invented a lamp to be taken into an explosive atmosphere, *Stephenson* 1560, 1561.

Clarke's Blower. Principle of Clarke's blower, which might be used as an auxiliary to the furnace, *Murray* 3322 3326.

Cleanliness. Pitmen generally are cleanly in their habits, *Fife* 1419–1424, *Stephenson* 1621.

Clubs. In clubs there are separate funds for men employed under-ground and those employed on the bank, and the payments in both cases are about equal; showing that the health of miners is not much affected by working in fiery mines, *Wood* 1491——In cases of accident in Staffordshire, there are clubs in the neighbourhood, and assistance is given by the owners to widows and families, *Forrester* 2800.

Coal. Coal in the north of England may be classed into bituminous or caking coal, and slaty coal, or that which does not cake, *Wood* 831——Different manner of drawing up coal in different mines, and quantity drawn up per day, *Stephenson* 1839–1847——Manner of landing the baskets at the top of the pit, *Buddle* 2391——Experiments tried upon coal, showing the porosity of different descriptions, and the quantity of gas in them upon their being cut in slices and submitted to a strong magnifying power, *Wood* 834–842——Extra expense of shafts should be laid on the price of coals, *Garforth* 3758, 3759——Comparative qualities of Staffordshire and Newcastle coal for burning, *Smith* 3811, 3812.——*See* also *Bituminous Coal. Fire Damp. Gas. Nova Scotia Mines.*

Coal-dust. Particles of coal diminished in magnitude, or extended in particular form, would become so light as to float about, and with particular currents of air would ignite, *Gurney* 11–13.——*See* also *Davy Lamp.*

Coal-owners. Independent of the feelings of humanity, the enormous expense of a serious accident would cause owners to use the greatest care in working mines, *Buddle* 2411, 2412, *Walker* 4176–4179.

Coal Stratifications. Are liable to considerable dislocations and interruptions, both in number and extent, *Wood* 833.

Collieries. See *Mines.*

Collingwood Main. Nature of the accident at the Collingwood main in 1815, *Johnson* 1302–1306.

Commission. A commission of scientific and practical men to examine the different mines, and make experiments on the spot, would be advantageous, *Wood* 1189–1191, *Johnson* 1383, *Stephenson* 1871, *Buddle* 2509, *Smith* 3178. 3827, *Birkbeck* 3943–3945, *Pereira* 3975–3977, *Walker* 4168.

Committee. See *Evidence. Parliamentary Inquiry.*

Concussion. Advantage of concussion, by means of cannon, in putting out flame when inaccessible by other means, *Buddle* 2095–2101.

Copper Mines. Particulars as to sinking shafts therein, *Taylor* 137–141——Working copper mines not more injurious to health than working other mines, *Taylor* 151, 152.
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Copper Wire. Objections to the use of copper wire in the Davy lamp, the result of experiments showing that fire-damp will dissolve it, *Murray* 3224–3231.——*See* also *Kite.*

Cornwall Mines. There is no inflammable air in the mines of Cornwall, *Vivian* 3009.
See also *Ascent and Descent. Black Damp. Foul Air. Miners. Ordnance Maps. Ordnance Survey. Polytechnic Society.*

Coroners. Townships and parishes in Durham were negligent in calling on coroners in cases of accident until Dr. Gray, afterwards Bishop of Bristol, and Sir John Bayley, interfered, *Wilkinson* 285.——*See* also *Accidents.*

Coroner's Bill. Provision should be made therein for their returns being made more accurately, *Smith* 3082, 3083.

Creeps. Nature thereof in coal mines, and evils which take place from the extra discharge of gas from the lower seams, *Wood* 847.

Crossings. Their nature and description, *Buddle* 1988.

Cumberland Mines. Depth of mines and thickness of seams on the western coast of Cumberland, *Buddle* 2285–2289.

D.

Dam-doors. Use of dam-doors, and manner in which they extinguished a heavy fire at the Whitehaven mine, *Buddle* 2294-2301.

Danger. Manner in which the appearance of the flame in the candle or the safety lamp indicates danger, *Gurney* 63–65——Added to noxious vapours, *Gurney* 76, *Clanny* 367——The lamp indicates proximity to danger by going out, *Stephenson* 1853——Sulphureous smell sometimes indicates inflammable air, but explosions generally come as rapidly as a flash of lightning, *Clanny* 367–369——If any accident is likely to occur in the absence of those in charge of the mine, the men are desired to leave their work and come home, *Winship* 572–576——The first appearance of danger is in the bords, where if the air explodes it does not generally go further, *Wood* 991.

Dashing the Air. The plan made use of to mix inflammable with other air, *Wood* 974.

Davy Lamp:

1. *Generally, and Effect of its Introduction.*
2. *Safety thereof.*
3. *Insecurity thereof.*
4. *Lamp Discipline, and Punishment of Miners for using it improperly.*

1. *Generally, and Effect of its Introduction:*

Common Davy lamp is preferable to that in which the seams are introduced, *Wood* 1000–1009——Evidence upon the safety of the common Davy lamp with glass, and improvements made thereon, *Wood* 1047–1067——Opinion against the use of the Davy lamp as protected by glass, *Johnson* 1337, 1338. 1345–1348——The men do less work with the lamp than candles, there is not so good a light from it, *Forrester* 2698–2703——Objections by pitmen to the use of the lamp, from its not giving so good a light, *Grundy* 4133–4138——The Davy lamp gives a more steady light than the steel mill, but is rather inferior to candles, *Elliott* 793–796——Many mines have been worked by the aid of the safety lamp which would otherwise have been valueless, *Winship* 503–505, *Elliott* 758–762, *Stephenson* 1639. 1664, *Buddle* 2393–2397——Introduction of the Davy lamp has had the effect of making the over-men more careless in the ventilation of the mine, *Stephenson* 1623. 1667——Whether the use of the Davy lamp may not have prevented greater care being taken with regard to ventilation, the lamp being subject to contingencies, *Murray* 3338. 3344——Number of Davy lamps in daily use in the mines of Northumberland, *Buddle* 2223.

2. *Safety thereof:*

Perfect confidence is to be placed in the common Davy lamp if it is in a sound state, *Johnson* 1329–1331. 1336. 1343, 1344——Experiments tried by Sir Humphrey Davy with his lamp upon his first inventing it, with witness's constant use of it (but against the current with a tin shield) for 20 years, shows that it is as near perfection as any human invention can be, *Buddle* 2226–2234. 2283, 2284——Witness has perfect confidence in the use of the Davy lamp; the men always withdraw when the lamp gets red hot, *Mitcheson* 2586, 2587——The Davy lamp is safe when used properly, *Embleton* 4056–4072. 4084–4088, *Walker* 4158-4160——When the gauze is red hot it is not prudent to keep the lamp long in that state, *Johnson* 1340–1342.

They keep working with the safety lamp red hot for some hours together in Earl Fitzwilliam's collieries, *Murray* 3253——The original safety lamp is perfectly safe, except in the case of sudden accident, *Winship* 553–555——Cases where the safety lamp has exploded internally when a candle would have fired the whole mine, *Winship* 446, 447——The Davy lamp is safe if precaution taken not to use it too quickly in an explosive atmosphere, *Elliott* 734–747, *Wood* 1036, *Fife* 1457–1465——If the lamp passed rapidly through an explosive atmosphere, the light would be extinguished before the flame would pass the gauze, *Johnson* 1338, 1339——Proportion of atmospheric air and carburetted hydrogen that will extinguish the flame, *Birkbeck* 3902–3907——Nature of Sir Humphrey Davy's lamp, and witness's improvement upon it to prevent its igniting from the flame passing through it, *Newman* 3558–3587.

Davy Lamp—continued.

3. *Insecurity thereof:*

Nature of the Davy lamp; it is experimentally but not practically safe, *Gurney* 14–28——It is a beautiful invention, and did great good; accidents it is liable to, *Wilkinson* 285——Opinion against the use of the Davy lamp as a preventive from danger, partly from the carelessness of the men, and partly from their working in more dangerous situations since it has been in use, *Taylor* 255–265——Danger from the use of the Davy lamp, and nature of the contingencies likely to affect witness's lamp, *Upton* 1940–1942——Circumstances which show the Davy lamp not to be altogether safe; accidents that have happened where it has been in use, *Clanny* 341–352——Experiments showing the manner the flame may be made to pass through the gauze, *Elliott* 818–820, *Upton* 1878–1887, *Ryan* 2939, 2940, *Stephenson* 2941–2944, *Murray* 3216–3223, *Birkbeck* 3883–3892, *Pereira* 3954–3961.

Experiments tried by witness at the London University, in the presence of the Committee, to show the insecurity of the Davy lamp, *Pereira* 4185–4205——Where accidents have happened during the use of the Davy lamp, some accident must previously have happened to the gauze of the lamp, *Johnson* 1334–1336——Instance of a lamp firing the carburetted hydrogen in a current of air, *Forrester* 2733–2740——Particles of coal coming against a red hot lamp would ignite the surrounding explosive atmosphere, *Murray* 3298–3302——How far accidents may happen from lamps getting deranged by coming in contact with external substances, *Wood* 1024–1028, *Buddle* 2185. 2224——How far explosions in northern mines may be accounted for by the lamp being used for exploring without sufficiently protecting it from the opposite current, *Murray* 3247–3253——Manner in which men shield their lamps from the opposing current when going through the air-courses, *Roberts* 3481.

Opinion against the cooling influence of the iron-wire used in the lamp, the lamp being more dangerous when cool; also opinion upon the external pressure of air on the flame, *Murray* 3232–3242——View of Sir Humphrey Davy in recommending the safety lamp was, that all that was required of science was sufficient light for the workmen, without endangering explosion, *Vivian* 3007——It is desirable that the public should be made acquainted in what respect the lamp is favourable, and in what respect deficient, *Stephenson* 1875——It has not been sufficiently published to the world that Sir Humphrey Davy had declared his lamp not safe under particular circumstances, *Smith* 3828, 3829——Many miners not aware at the present time that the lamp is unsafe, *Smith* 3830. 3835, 3836——Ignorance of coal-owners and miners of the accidents to which the Davy lamp is liable, *Upton* 3986, 3987.

4. *Lamp Discipline, and Punishment of Miners for using it improperly:*

Miners can trim the Davy lamps without opening them; in some cases the wire gauze may be broken by accident, but the lamps are generally opened wilfully, which causes danger *Gurney* 39–46——There is a very strict law for the punishment of any person who unscrews his Davy, *Winship* 481–484——Instance of the discharge of men for taking off the tops of their Davy lamps, *Johnson* 1311. 1327, 1328——Accidents have happened since the introduction, from the carelessness of the pitmen, *Elliott* 749–753——The men will open their lamps when the air is free, and from the sudden appearance of a blower of gas accidents sometimes happen, *Elliott* 768–772——If the light of the Davy lamp could be increased it would be advantageous, particularly in inducing men not to remove the gauze, *Elliott* 797–802.

It is the duty of the pitman himself to clean the top of his own lamp himself, *Johnson* 1326——Nature of the lamp discipline, or manner in which the lamps are cleaned and taken care of, and the colliers supplied with fresh lamps as occasion requires, *Buddle* 2242–2251——Manner in which the colliers themselves at present enforce attention to the use of the Davy lamps, and agree with the punishment of men convicted of wilful neglect, *Buddle* 2253–2255——Are cleaned every day in the Durham mines, *Winship* 529——The lamps are all locked in pits under the best management, *Winship* 530. 531——Manner in which lamps are inspected daily, previously to their being used in mines, *Wood* 1010–1016.

See also *Accidents. Air. Clanny's Lamp. Carburetted Hydrogen. Copper Wire. Explosions. Green Dock Pit. Hemming*, Mr. *Magistrates. Pipes. Platina. Safety Lamps. Wire Gauze.*

Davy Lamp Keepers. Their duties of inspection of the lamps before the pitmen are allowed to go to their work, *Johnson* 1324, 1325, *Buddle* 2186. 2188. 2248——Duties of the Davy boy Kepple, mentioned in the evidence on the inquest, *Buddle* 2354, 2355.

Davy, Sir Humphrey. His experiments upon the result of white heat in causing explosions, *Wood* 1073–1075——Witness's opinion upon the statement of Sir Humphrey Davy relative to the construction of certain safety lamps, *Stephenson* 1540–1543——Value of the service of plate presented to him for his discovery, *Buddle* 2417, 2418.

See also *Davy Lamps.*

Dean Forest Mines. They are exceedingly simple, they are worked by adits generally, and scarcely any gas is made, *Buddle* 2476.

Deaths. Number of, that took place in 1815, previous to the introduction of the Davy lamp, *Buddle* 2375.——*See* also *Casualties.*

Deep Field Colliery. Witness's plan of ventilation tried in Deep Field Colliery, near Bilston, where the coal is not so deep, *Ryan* 2866–2872.

Deputy

Deputy Overman. His duty, *Johnson* 1322.

Derbyshire Mines. Mr. Gisborne's mine there is well conducted, a good deal of coal is got out, but it is of an inferior description, *Forrester* 2818——Accidents in mines in Derbyshire, during the last 35 years, *Walker* 4162–4164.

Dillon, Mr. (Analysis of his Evidence.)—Result of an experiment by placing a lamp with a gauze perfectly cold, in an explosive mixture, 4255–4257. 4259–4262——The shield of talc in witness's lamp is a perfect security in any coal mine, 4269.

Dip of Mines. See *Mines.*

Division of Boilers. The division of boilers into small chambers, so that if the explosion should happen, under the best protection, would considerably add to personal safety; in short, amount to perfect safety, *Gurney* 103, 104.

Drift. Width of proposed drift, and quantity of coal that could be worked in 24 hours, *Martin* 300–310——Meaning of the term as used for mining, *Buddle* 1988.
See also *Leading Drifts. Legislative Interference.*

Dudley Mines. Mines at Dudley subject to frequent and tremendous explosions, *Stephenson* 1817, 1818——Accident and loss of life at Oldbury, near Dudley, in September 1833, *Stephenson* 1819.

Durham District. See *Ascent and Descent. Northumberland and Durham.*

Durham, Lord. Lord Durham's mines are subject to fire damp, *Winship* 419, 420.

Durham Society for Prevention of Accidents. Particulars as to the formation of a society for preventing accidents in coal mines in Durham, *Wilkinson* 285——Dr. Gray considered the production of Sir Humphrey Davy's lamp a sufficient reason for putting an end to the proceedings of the society, but the other members did not so consider it, *Clanny* 328–330.——*See* also *Mining Society. Northern Mines.*

E.

Earth. Trees are shattered by lightning, which goes into the earth, but the earth is not disturbed, *Stephenson* 1718.

Edinburgh. See *Experiments.*

Education. State of the education of children employed in the mine, *Winship* 613——A very considerable proportion of the grown-up pit-men can read, *Wood* 1198——The love of reading has increased among the miners, but the moral character of them has not improved, except as regards the rising generation, *Wood* 1195. 1196——A large proportion of the miners are able to read, and the rising generation, without exception, are taught to read, *Johnson* 1489.——*See* also *Miners. Sunday Schools.*

Electric Fluid. See *Kite.*

Electric Machine. Experiments upon the explosion of air and fire-damp by means of an electrical machine, *Stephenson* 1712.

Elliott, Ralph. (Analysis of his Evidence.)—Over-man and manager of the waste in Lord Londonderry's mines at Penshaw, Durham, 628——Penshaw mines are all fiery in a greater or less degree, 634–636——Accident at the Plain pit at Rainton, for which there was no accounting, 639–653——Particulars as to the accident which took place at the Lawson main colliery, in Northumberland, in 1802, 662–674——Accident at Mr. Russell Church's pit, and loss of life by choke-damp, 675–683——Proportion of men destroyed by the choke-damp after explosion is as three to one over those who are actually burnt, 684, 685. 692——There are no marks on the bodies of men dying from suffocation; those dying from the explosion are shattered to pieces, 686–691——Explosions sometimes take place without the ventilation being destroyed, or men in other parts of the mine being aware of the fact, 693–696.

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Inspector of Mines. It would be advisable that a public officer should be appointed to inspect mines, with a view to prevent accidents, *Stephenson* 1812–1816.——*See* also *Mines.*

Instructions to Miners. Printed instructions to the pitmen, in their several grades, annually distributed, would be of advantage, *Stephenson* 1701–1704. 3791, 3792, *Forrester* 2802–2806, *Smith* 3831——Annual printed instructions of the dangers to be avoided by the miners would do no harm, though they would require continual enforcement to impress upon a man the necessity of practising them, *Wood* 1178, 1179——By whom instructions against danger would be given to men coming from the lead-mines to work in the Killingworth colliery, *Wood* 1180–1186——In what manner miners might be made to understand the dangers of their situations, and the necessity of taking proper care of their lamps, *Fife* 1483–1487——Notices that are given in the northern mines of places which are prohibited for the workmen to enter, *Buddle* 2467, 2468.

In Take. Meaning of the term, as made use of in mining, *Buddle* 1988.

Inundations. Cases of inundations of mines are of very rare occurrence, *Taylor* 174, 175——Loss of life at Mr. Fletcher's works at Little Lever, from the river breaking in on the works, *Grundy* 4123–4126.——*See* also *Heaton Colliery.*

Iron-stone Mines. Nature of accidents that happen therein, *Forrester* 2819–2821——Manner of working iron-stone mines; miners therein are not subject to the same sort of accidents as pitmen are, *Smith* 3137–3141.

Irruption. See *Explosions.*

J.

Jarrow Colliery. Is considered a fiery mine, *Johnson* 1295——Is nearly as fiery as the Wallsend colliery, *Buddle* 2160——Work written by witness upon the cause of the explosion in the Jarrow colliery in 1830, *Buddle* 2017–2019——Number of lives saved at the Jarrow colliery by the presence of mind of the under-viewer in throwing open the main doors after the pit had fired at the furnace, *Buddle* 2995, 2996.
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Johnson, George. (Analysis of his Evidence.)—In different mines there are different ways of carrying on the ventilation, but the principle is the same in all, 1249——The air pump at Heaton colliery has from its inefficiency been replaced by the furnace, 1251–1258——Particulars of an accident in the Wilmington colliery, in consequence of coming suddenly in contact with a blower of gas, and means taken to draw off the gas, 1259–1284——Nature of the accident at the Collingwood main in 1815, 1302–1306——If the use of safety lamps enforced in every case it would lead to greater carelessness on the part of the men, and in the ventilation of the mine, and when an accident did happen it would be attended with more fatal consequences, 1307–1310. 1340——Instance of the discharge of men for taking off the tops of their Davy lamps, 1311. 1327, 1328——Particulars of an accident in the Wilmington colliery, from the imperfect state of a Davy lamp, 1312–1321——Gradation of workmen, and their duties, 1322–1328——Perfect confidence is to be placed in the common Davy lamp, if it is in a sound state, 1329–1331. 1336. 1343, 1344——Where accidents have happened during the use of the Davy lamp, some accident must previously have happened to the gauze of the lamp, 1334–1336.

If the lamp passed rapidly through an explosive atmosphere the light would be extinguished before the flame would pass the gauze, 1338, 1339——When the gauze is red hot it is not prudent to keep the lamp long in that state, 1340–1342——Opinion against the use of the Davy lamp, as protected by glass, 1337, 1338. 1345–1348——The common miners place great confidence in the people above them, and do not take that concern about their personal safety which they ought to do, 1350–1353——In the event of a sudden irruption of a blower, or the breaking down of a stopping, the air course would not be, generally speaking, so quickly cut off as to cause ignition before the men could reach the shaft, 1353–1357——Accident at Walker's colliery in 1823, was from the rubbish falling on the men clearing away an old shaft, and did not take place in the body of the mine, 1358–1360——The number of persons continually passing and repassing keeps the children at the trap-doors attentive to their duties, 1369, 1370——Accidents more frequently occur from the back overman not seeing the doors left in a proper state when the men leave their work, than from the carelessness of children while the mine is working, 1371–1373.

Accidents sometimes happen from the roof of the mine falling in, although every precaution may have been taken, 1375–1378——Advantage of a complete map of the mineral districts in the Tyne and Wear, 1385–1387——Desirable that Government should give directions for the publication of the Ordnance survey, with the view to the completion of such a map, 1388, 1389——Widows of men who die from accidents are allowed to live in their houses for the remainder of their lives, and are provided with an abundance of fire coal, 1488——A large proportion of the miners are able to read, and the rising generation, without exception, are taught to read, 1489——Allowances made by coal-owners to men who meet with accidents, and period that allowance is continued, 1490.

Judges. Of assize, in their charges to juries, have dwelt upon the necessity of indicting managers, where cases of neglect could be proved, *Buddle* 2409, 2410.

K.

Killingworth Colliery. There were faults in all directions in this mine, *Stephenson* 1602, 1603——In this explosion, the blowing off the bottom part of the bratice, and thereby destroying the main current, would not have occurred if there had been two shafts, *Stephenson* 1607, 1608——Some men killed there by stone recently, *Buddle* 2098——No explosion there for 12 years, though the pit worked altogether with lamps, *Mitcheson* 2588——Accident therein from a miner meeting with a sudden discharge of gas, *Wood* 994——Examination upon the working plan, showing the dykes that have been met with therein, *Wood* 842–845——Explanation of plan illustrating the accident which occurred at Killingworth colliery, *Wood* 1085——Number of accidents that have happened in Killingworth colliery to an average of 500 men in 15 years, *Wood* 1109–1116——Particulars of an explosion in the Killingworth colliery in 1806, also of another in 1809, *Stephenson* 1510–1529.

See also *Ascent and Descent. Candles.*

Killingworth Mines. See *Furnaces. Machinery.*

King's Swinford Mines. Mr. James Foster is working the thick mine on the principle of long work, *Smith* 3145–3147.

Kite. Experiments upon collecting the electric fluid by means of 500 yards of copper wire attached to a kite, *Stephenson* 1714.

L.

Ladders. See *Ascent and Descent.*

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Lancashire Mines. Mines near Newton, in Lancashire, are foul, and accidents have happened within the last 18 months, *Stephenson* 1757–1763——Nature of the Lancashire system of working mines, *Buddle* 2111.

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Lawrence, St., Colliery. Explosion at the St. Lawrence colliery, and loss of life to some masons building a wall, *Fife* 1466–1477.

Lawson Main Colliery. Particulars as to the accident which took place at the Lawson Main colliery in Northumberland in 1802, *Elliott* 662–674——Particulars of the ignition of the gas by lightning at the Lawson mine, *Buddle* 2199–2209.

Lead. In what manner lead might be inserted in a boiler, which would melt when danger was at hand, *Gurney* 109, 110.

Lead Mines. Necessity for cleanliness in the men working therein, who suffer much in their health, *Wilkinson* 285.——*See* also *Health. Veins.*

Leading Drifts. Nature of leading drifts used for exploring danger and keeping the main workings free, *Wood* 1097, *Johnson* 1363, 1364.——*See* also *Old Workings.*

Lecturers. No difficulty in a popular lecturer making the subject of accidents understood by ignorant miners, *Birkbeck* 3949, 3950.

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Legislative Interference. Is only useful with regard to accidents in mines where a case of neglect can be made out, *Buddle* 2407, 2408——It would be considered a grievance by both masters and men, *Forrester* 2792——It is not needed in Lancashire, *Walker* 4166, 4167——The Legislature should allow any person's property to be entered for cutting a drift along a fault if proper compensation made, *Ryan* 2932——Difficulty of a legislative enactment with regard to mines, *Grundy* 4131, 4132.

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Leicestershire Mines. The aid of a safety lamp has hitherto been dispensed with, the mines being so well ventilated by means of a furnace, *Stephenson* 1768–1772.

Leige Mines. Dangerous state of mines at Leige, *Stephenson* 1791–1797——They are worked rather extensively, *Stephenson* 1811.

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Leyden Jar. Experiments upon the explosion of different mixtures of gas by means of a Leyden jar, *Stephenson* 1713.

Lighting Mines. Different modes of lighting mines, *Wilkinson* 285——Possibility of lighting mines without taking flame into them at all, by means of artificial lights placed in parabolical reflectors, *Gurney* 77–97——It would be more difficult in a Cornish mine than in a colliery, but it might be applicable to some extent, *Taylor* 267——It would be extremely difficult, if not entirely impracticable, *Wood* 1242–1245, *Buddle* 2487–2492——Witness's experiments show that it is possible, but could not be kept up to such an extent as to be useful, *Stephenson* 1734–1744.
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Lightning. Doubts as to a magazine of inflammable air being exploded by lightning going through the earth, *Stephenson* 1705–1733——Explosions do not take place from lightning except from ignition of the gas at the top of the pit, *Buddle* 2198.
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Local Records. See *Explosions. Sykes' Local Records.*

Long Work. See *Mines.*

Lothian and Fife Mines. Mines in Lothian and Fife are subject to fire-damp in a very trifling degree, *Buddle* 2425–2427.

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Lumley. See *Charles Pit.*

M.

Machinery. Suggestions of witness which first substituted machinery in bringing coals out of deep workings for manual labour and horses in the Killingworth pit, *Stephenson* 1501–1509.

Magistrates. There is a readiness in them to punish carelessness in the use of the Davy lamp, *Buddle* 2255.

Main Doors. Description of them, and manner in which they are specially secured, *Buddle* 1988——It takes some time before neglect on the part of the boys or injury to the doors would effect the general ventilation of the mine, *Buddle* 2168–2172——Their nature and description, *Buddle* 1988.

Manor Wallsend Colliery. There is but a trifling quantity of gas therein, *Buddle* 2160.

Maps. Are more necessary in collieries than in copper mines; they are getting more appreciated now than they were formerly; there is a draftsman generally employed in large concerns, *Taylor* 176-184——Pamphlets of Messrs. Chapman, on the propriety of having

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Martin, John. (Analysis of his Evidence.)—Suggestion of a plan for preventing accidents in mines, 287–291——Accidents occur from the foul air at angular recesses and trap-doors in mines being set in motion in some cases by carelessness, 292, 293——Proposed plan of working coal mines, by which the mines would be thoroughly ventilated and more coal obtained, 295–297——Number of shafts in coal mines, and advantage of witness's plan in lessening the distance coals will have to be brought, 298, 299——Width of proposed drift, and quantity of coal that could be worked in 24 hours, 300–310——Commencing the working of mines directly the bottom of the shaft is gained is not a judicious plan, and is done at peril, 311, 312——The better the coal the more it is exposed to fire-damp, 313–316——The best plan is to drive the level right on; more coal is obtained when driving the level, 319, 320.

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[Third Examination.]—Proposed system of working mines with a view to better ventilation, 3989–3997——Opinion in favour of the use of a fan over a furnace, 3998–4002——Part of the mine necessary to be sacrificed under witness's plan, to prevent accumulations of gas, and save expense of trap-doors, &c. 4003–4012——Necessity for pits being drained of water as well as ventilated from gas, 4013–4018.

Mathematics. Many of the miners are tolerable mathematicians in the lower departments of that science, and there is a tendency certainly to learn and acquire information of that kind, *Taylor* 223.

Mechanics' Institutions. Advantages that would result from mechanics' institutions and Polytechnic schools, and how far they have been established, *Smith* 3172–3177.

Medical Attendance. Owners of collieries generally have what they consider competent medical attendance, *Fife* 1406, 1407——Competition among medical men for attendance on collieries would be injurious, *Fife* 1408–1410.

Medical Treatment. Nature of the medical treatment resorted to for restoring suspended animation, *Buddle* 2503–2508——After the animation of inferior animals has been suspended nearly 10 minutes, it has been restored by immersion in cold water, *Murray* 3346, 3347——Best mode to be adopted for restoring suspended animation, *Birkbeck* 3940–3942.——*See* also *Surgical Treatment.*

Meesham Colliery. Accident thereat in 1821, *Winship* 461.

Merthyr Tydvil Mines. Thickness of the seams in Mr. Guest's mines at Merthyr is great, the beds good; there is but little gas, and the mines are well ventilated, *Buddle* 2469–2474.

Middleton Colliery. Depth of shafts and particulars as to mines belonging to the Rev. R. H. Brambling, at Middleton, near Leeds, *Embleton* 4020–4027. 4034–4039——Formation of carburetted hydrogen therein does not generally affect the safety of the men, *Embleton* 4028–4032.

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There is not any particular repugnance on the part of miners to their work, even after accidents, *Fife* 1418——There is no difficulty in supplying the places of men who have been lost by accidents, in a short period, *Wood* 1210–1214——The men go to work immediately after an accident, *Forrester* 2683–2686——They do not obtain so much coal individually as they did; they do not work so hard now, *Buddle* 2414——Cornish habits are introduced into the mines in North Wales, to the benefit of the workmen, *Taylor* 274——The miners in Cornwall work very much in wet places, but they invariably change their clothes and wash themselves when they rise to the surface, *Taylor* 224–235. 271——In North Wales they adopt the Cornish custom of changing their clothes, *Taylor* 274.

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vided for them, *Fife* 1411–1416——Position in which the men work, *Winship* 595–597——Gradation of workmen and their duties, *Johnson* 1322–1328——The common miners place great confidence in the people above them, and do not take that concern about their personal safety which they ought to do, *Johnson* 1350–1353——The men's carelessness only endangers their own lives in Staffordshire; they are sometimes remonstrated with by their fellow-workmen and the over-men, *Smith* 3092–3097——How far the workmen are aware of what the points of risk are; it is only fool-hardy men who run into danger, *Smith* 3169, 3170——Men have prejudices against new systems of working, but would comply with any reasonable request of their employers, *Smith* 3085.

See also *Accidents. Cleanliness. Davy Lamps*, 4. *Education. Explosions. Eyes*, Disorders in. *Falling Coal. Health. Hewers. Hours of Labour. Instructions to Miners. Lead Mines. Magistrates. Mathematics. Sunday Schools. Tamping Needles. Trades' Union. Ventilation. Wages.*

Mines. Depth of pits in the north, *Winship* 426——Variation of the dip in mines, *Buddle* 2320–2324——Names of the principal collieries in Staffordshire now at work, *Forrester* 2604——Manner in which the mines in Staffordshire are overlooked by a bailiff, who reports to the viewer every night, *Forrester* 2780–2784——Mines in the north invariably inspected during the Sunday, *Winship* 615–621——Mine is always cooler on Monday mornings than on other days of the week, *Winship* 612——Description of collieries that have inflammable gas, and of those that are free from it, *Wood* 1086–1088.

In Yorkshire and North Wales the mines are worked by Cornish agents, in the same manner the Cornwall mines are, *Taylor* 269——The foresight used in sinking shafts before they are wanted is a great improvement in modern mining, *Taylor* 136——Accidents may happen from improper working, *Wilkinson* 285——Commencing the working of mines directly the bottom of the shaft is gained, is not a judicious plan, and is done at peril, *Martin* 311, 312——It is better to drive to the boundary, and work home, if it can be done, but there are many mines that could not be worked profitably in that manner, *Martin* 319, 320, *Stephenson* 1592–1596.

Further evidence as to the best mode of working mines, with a view to ventilation, and obtaining most produce, *Stephenson* 1696–1700, *Buddle* 2110–2121——Further evidence as to the mode of working, and number of yards the level proceeds in a day, and week, *Forrester* 2657–2665——Mode of driving the drift, and number of yards it progresses in 24 years, *Smith* 3122–3133——Method of working mines in Lancashire, *Garforth* 3601–3612.

The principle of long work has never been fairly tried with thick seams; how far it is likely to be advantageous or otherwise, *Smith* 3059–3069——System of working by long wall does not answer in all cases, *Buddle* 2106——It would not do for the mines in the north, *Mitcheson* 2581–2583——Or for thick seams, *Forrester* 2785–2791——Difficulties in working so as to clear out the coal at once, on account of the space left forming large gasometers, *Buddle* 2022–2027——Proposed plan of working coal mines, by which the mines could be thoroughly ventilated, and more coal obtained, *Martin* 295–297——Part of the mine necessary to be sacrificed under witness's plan, to prevent accumulations of gas; and save expense of trap-doors, &c., *Martin* 4003–4012.

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Mining Society. There was greater vigilance in working the mines after the formation of the society at Durham for preventing accidents, *Wilkinson* 285——Beneficial results that might be expected from a society patronized by the leading gentry of the district, having for its object the obtaining information relative to mining, and diffusing that information, so as to call forth native talent, *Wood* 1192–1194. 1197.

Mirrors. To what extent the lighting pits by means of mirrors, which was formerly tried in the Wallsend colliery, was successful, *Buddle* 2489–2492.——*See* also *Hand-saw.*

Mitcheson, George. (Analysis of his Evidence.)—Mine-agent at Lane-end, in the Staffordshire potteries, 2511, 2512——Depth of coal and extent of seams in mines in the Staffordshire potteries, 2513–2518——Proportion of gas therein as compared with mines on the banks of the Tyne and Wear, 2521–2525——Number of men who have been destroyed by explosions therein within the last seven years, and number who have perished from other causes, 2526–2533——Mode of ventilating mines in Staffordshire, 2534–2546——Difficulty in Staffordshire in getting the men to use the safety lamp as

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Mostyn Colliery. Adoption of witness's plan at the Mostyn colliery, *Ryan* 2880–2884.

Murray, John. (Analysis of his Evidence.)—Lecturer on chemistry at Hull, 3192, 3193——Proposed method of ventilating mines by means of tubes, 3197–3215——Instances in which the current of air may be forced through the gauze of the safety lamp, 3216–3223——Objections to the use of copper-wire in the Davy lamp, the result of experiments showing that fire-damp will dissolve it, 3224–3231——Opinion against the cooling influence of the iron-wire used in the lamp, the lamp being more dangerous when cool; also opinion upon external pressure of air on the flame, 3232–3242——How far explosions in northern mines may be accounted for by the lamp being used for exploring without sufficiently protecting it from the opposite current, 3247–3253——Manner in which oxydation of iron-wire may be prevented by the attachment of ribbons of zinc to the lamp, 3254–3257.

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Netherton Mine. Particulars of the plan adopted by witness at the Netherton mine, near Dudley, for clearing out the gas, *Ryan* 2840–2865.

Newbottle Colliery. Accident at the Newbottle pit in 1815, the safety lamp not being in use there, *Winship* 455, 456, *Buddle* 2372. 2374——Case at Newbottle of the loss of six men's lives from inhaling sulphuretted hydrogen gas, the lamps burning after the death of the men, *Stephenson* 1853–1858——Loss of one life in Newbottle colliery, and loss of life that might have been occasioned, *Roberts* 3388–3397.

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Newcastle-under-Lyne. State of dislocation in mines in Newcastle-under-Lyne, *Stephenson* 1796–1798——Local records at Newcastle show there is not a life lost in 10 years on an average of the last 50 years, *Ryan* 2834–2837.

Newman, John. (Analysis of his Evidence.)—The maker of the first lamps sent by Sir Humphrey Davy into the north, 3555–3557——Nature of Sir Humphrey Davy's lamp, and witness's improvement upon it to prevent its igniting from the flame passing through it, 3558–3587.

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North Wales Mines. Extent of seams in the mines in North Wales; the ventilation is too much left to the miners, *Buddle* 2453–2466.

Northern Mines. Explosions, inundations, &c., which have taken place in the coal mines of Northumberland and Durham, extracted from Mr. Sykes' Local Records of those counties, and corrected by witness, *Buddle* 3003.
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Northumberland and Durham Mines. A very great proportion of the collieries in Northumberland and Durham do not produce gas, *Wood* 1088.
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Nova Scotia Mines. Safety lamps are in use in the mines in Nova Scotia, *Smith* 3815, 3816——Extent of gas in mines in Nova Scotia, and mode of ventilation, *Smith* 3801–3808. 3817–3823——Quantity of coal obtained, and that can be obtained, from the mines in Nova Scotia; difficulty of finding a market there, *Smith* 3840–3842——Price of coal at Nova Scotia and Cape Breton, *Smith* 3843, 3844——To what extent explosions have taken place in Nova Scotia, *Smith* 3866.

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O.

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Old Workings. Instances in which the quantities of carbonic acid gas has prevented the descent into old workings, *Wood* 874——When the extent of the old workings is doubtful, great precaution is taken, by drifting and boring, in approaching them, *Johnson* 1390, *Wood* 1091–1095——Danger that arises from breaking into old workings, *Wilkinson* 285.——*See* also *Maps.*

Oil Lamps. They are used in the north in the horse roads, but not where the men work, *Stephenson* 1637.

Ordnance Map. Advantage of the Ordnance map in Cornwall and Devon, *Taylor* 219–221.

Ordnance Survey. Desirable that Government should give directions for the publication of the Ordnance survey, with the view to the completion of a map of the mineral districts, *Johnson* 1388, 1389.

Overmen. Their duty, *Johnson* 1322.

Oxclose Mine. Forty people lost by an explosion, *Johnson* 1291.

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P.

Parabolical Reflectors. See *Lighting Mines.*

Parliamentary Inquiry. Advantage of Parliamentary inquiry into the cause of accidents in mines, in inducing scientific men to take the matter into their consideration, *Elliott* 774–777, *Johnson* 1381——Advantage will be derived from the result of the present inquiry being laid before the public, with the plans, shortened so as to be intelligible to persons not practically acquainted with the subject, *Stephenson* 1872–1874.

Partington, Mr. His experiments on Upton & Roberts' lamp were not many, he appeared satisfied with the principle at once, *Upton* 1924.

Pendleton Colliery. It is a very inflammable mine, *Stephenson* 1702–1704——Copy rules to be attended to by workmen therein, *Stephenson* 3791, 3792.

Penshaw Colliery. The mines are all fiery in a greater or less degree, *Elliott* 634–636——There has not been one accident there in twelve years, *Elliott* 637, 638.
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Staffordshire. In mines in Staffordshire the men are less liable to accidents from gas, but more liable to be crushed from coal falling on them, than in the north of England, *Wood* 1227–1238, *Stephenson* 1750–1755——The Davy lamp is not much used in Staffordshire, it not giving sufficient light to work thick seams by, *Upton* 1954–1959——Difficulty in working the magnificent seams in Staffordshire, so as to obtain a greater quantity of coal, *Buddle* 2481, 2482——Principle of ventilating the thick seam in the Dudley district of the Staffordshire mines is good, the height of the seams making the operation easy, *Buddle* 2446——Mode by which the thick seams in the Staffordshire mines are worked, and by which accidents are occasioned, though great care is taken, *Buddle* 2450–2452——Depth of coal and extent of seams in mines in the Staffordshire potteries, *Mitcheson* 2513–2518——Mines in south Staffordshire are ventilated on witness's plan, *Ryan* 2897–2900——Names and depth of mines in Staffordshire under witness's inspection, *Smith* 3013, 3014——The lamps are no use to the men for working in the Staffordshire mines, *Roberts* 3488–3490, *Smith* 3835, 3836.
See also *Accidents. Ascent and Descent. Gas. Grenville,* Earl. *Mines. Ventilation.*

Staffordshire Miners. See *Miners.*

Stagnant Water. Has a great deal to do with the generation of gas in the coal, *Smith* 3806. 3809, 3810.

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Stanley, Sir *Thomas.* His mines in Flintshire not fiery, *Stephenson* 1780, 1781.

Steam. Proposition for ventilating mines by means of high pressure steam, *Gurney* 3867–3872.

Steam Boilers. There has not been much loss of life occasioned by the bursting of steam-boilers in Cornwall, *Taylor* 236——Invention of a man working in the Perran foundry, of a mode of ascertaining the quantity of water in a steam-boiler, *Taylor* 209——Examination upon the best construction of steam-boilers to prevent accidents from bursting, *Gurney* 103–112——Accidents by bursting in steam-boilers are mostly from the circumstance of the boiler not being sufficiently filled with water, *Gurney* 98–102.
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Steam Engines. Extent of power employed in the mining districts of Cornwall, and number of pounds per inch the engines are worked, *Taylor* 237–239——Use of, in ventilating mines in Staffordshire, *Mitcheson* 2536.

Steam-engine Chimnies. Velocity of air, according to height, in steam-engine chimnies, *Wood* 904–907.

Steel Mills. Have not been in use for the last 20 years; accidents have happened from the use of them, *Winship* 506–512——Manner in which their danger was discovered, *Buddle* 2489.——*See* also *Davy Lamp.*

Stephenson, George. (Analysis of his Evidence.)—Civil engineer, formerly resident in the north of England, but now residing in Leicestershire, 1494, 1495——Suggestions of witness which first substituted machinery in bringing coals out of deep workings for manual labour and horses in the Killingworth pit, 1501–1509——Particulars of an explosion in the Killingworth colliery in 1806, also of another in 1809, 1510–1529——Experiments tried by witness formerly in lighting blowers of gas, and his attention consequently drawn to forming

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forming a lamp, 1530–1536—— Experiments which led witness to the construction of his lamp, its nature, period when first tried, comparison with that invented by Sir Humphrey Davy, 1537–1551——The Killingworth mine is very inflammable, and there have been but few accidents therein since witness's lamp has been used, 1552–1556——The lamp, No. 5, with the improvements with respect to the glass, is more perfect than any other lamp, 1557, 1558——Mr. Roberts' lamp, from having the glass placed externally, is objectionable, 1559– ——Dr. Clanny's lamp is very ingenious, the only difficulty is in getting the miner to manage it, 1559–1561.

Different circumstances which may cause a stoppage in the ventilation of mines, 1562–1264——The explosion at Killingworth mine was for want of a furnace, and the day the accident happened the overlookers were so alarmed that they caused preparations to be made for the furnace that night, 1565–1567——The construction of a large fan, upon the system of a winnowing machine, would be useful as an assistance to the furnace, but there would be difficulties in the way of carrying it into effect, 1568–1577. 1695——Advantage if some means could be adopted of measuring the quantity of air passed to the most distant part of the mine, 1578——Increasing the size of the furnace at the bottom would much more effectually answer all the purposes of a furnace at the top, 1579–1582——There has been no improvement within the last 10 or 20 years in the mode of ventilating mines, 1583–1585——System of ventilation for rooms would not be applicable to mines; pipes would not do on account of the distance the air has to travel, 1586–1588——The greatest danger, with respect to explosions, is in working the pillars, 1589—— Better to work the pillars as they go on, where it can be done, though it cannot be done in all mines, 1590.

It is better to drive to the boundary and work home, if it can be done, but there are many mines that could not be worked profitably in that manner, 1592–1596——It is more difficult to manage the ventilation in an ascending than in a descending mine, 1599—— A shaft at the upper end would prevent the difficulty, but for the faults which in many cases intervene in all directions, 1600, 1601——Many accidents happen from the air collecting in cavities out of which the coal has been worked, 1603, 1604——The ventilation is more perfect by having two shafts than one braticed shaft, 1606–1608——Early ages at which children are employed at the trap-doors for the purposes of ventilation, in some cases without harm, but in dangerous situations very improperly, 1611–1620——Introduction of the Davy lamp has had the effect of making the overmen more careless in the ventilation of the mine, 1623. 1667——Men are compelled to use the Davy lamp if the overman gives orders, though in many cases they would rather use the candle, 1624–1636——Difficulties with regard to the ventilation of mines, particularly in large workings, showing the impossibility of so ventilating as to render a candle always safe, 1640–1644.

Ventilation depends on the size of the pits compared with the extent of the workings, the Davy lamp has reduced the number of pits in a given quantity of mining, 1645–1648——The sinking two shafts would insure a more perfect ventilation than one braticed shaft, and which is a point sufficient to justify legislative interference, 1649–1659——For partitions a brick stopping is better than a bratice, 1660, 1661——Manner in which bratices are made use of for conveying air to the men, 1662, 1663——Many mines have been worked by the aid of the safety lamp, which would otherwise have been valueless, 1664——Those owners who have not had serious misfortunes in their mines have gained pecuniary advantages from the safety lamp, 1665, 1666——Necessity for there being a large barometer at the bottom of each mine, as accidents have usually taken place when the barometer has stood low, 1668–1673. 1682–1685——State of the ventilation of mines in summer and winter, and in what manner shown by the barometer, 1676–1681——Miners have in some cases refused to work during a warm south-west wind, 1685, 1686.

Cause of blowers issuing from rocks, distance from which they come, and number of years they have been known to last; there would be difficulty in stopping them, 1687–1692——Further evidence as to the best mode of working mines, with a view to ventilation, 1696–1700——Printed instructions to the pitmen, in their several grades, annually distributed, would be of advantage, 1701–1704——Doubts as to a magazine of inflammable air being exploded by lightning going through the earth, the earth being too moist to hold the electric spark, 1705–1733——Witness's experiments upon Mr. Gurney's mode of lighting mines by reflection, show that it is possible, but cannot be kept up to such an extent as to be useful, 1734–1744——Mines in Staffordshire are fiery, but less so than in the north; the miners run a risk of explosion, but not so much so as in the north, from the limited scale of workings, 1750–1755——Mines near Newton, in Lancashire, are foul; and accidents have happened within the last 18 months, 1757–1763.

The mines in Leicestershire are at present so well ventilated with the furnace that there has been as yet no necessity for the safety lamp, 1768–1772——Dangerous state of mines near West Bromwich in Warwickshire while candles were used, 1773–1779—— Dangerous state of the mines in Belgium, and manner they are worked, 1791–1797—— State of dislocation in mines in Newcastle-under-Lyne, 1796–1798——Advantage if there were some fixed rule as to the quantity of atmospheric air that should be always in mines for the purposes of ventilation, and difficulty of forming any such fixed rule, 1799–1809——It would be advisable that a public officer should be appointed to inspect mines, with a view to prevent accidents, 1812–1816——Mines at Dudley subject to frequent and tremendous explosions, 1817, 1818——Accident and loss of life at Oldbury near

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Dudley in September 1833, 1819——The system of ascending and descending in Leicestershire is by means of the corves; the ascent by rope and loop in the north seems very dreadful, 1821–1827.

Accidents at Lord Hastings's colliery near Ashley, by which several men were drawn over the pulley and lost their lives, 1828, 1829——Particulars as to the contrivance at Mr. Sparrow's colliery, at Lane-end in Stafford, for landing men and coals, but which is not applicable for a large quantity of coals, 1830–1835——Small space of time in which men are brought up a distance of 265 fathoms, 1836–1838——Different manner of drawing up coals in different mines, and quantity drawn up per day, 1839–1847——Instance of a man being killed while going down a shaft, in consequence of inhaling carbonic acid gas, from the bad ventilation of the mine, 1848–1852——Case at Newbottle of the loss of six men's lives from inhaling sulphuretted hydrogen gas, the lamps burning after the death of the men, 1853–1858——Health of miners in the north is as good as that of the labouring classes on the surface, 1859–1861——Healthy state of horses working in coal mines, 1862–1864.

Coal-miners a more healthy set of men than lead-miners, 1865, 1866——Gunpowder should not be used where large coals are wanted, as the exposure to the atmosphere after the shock causes the coal to fall to pieces, 1867–1869——Premiums being offered by coal-owners would be the means of bringing native talent forward, 1870——Good might arise from scientific men being induced to visit the mines and make experiments, 1871——Advantage will be derived from the result of the present inquiry being laid before the public, with the plans shortened, so as to be intelligible to persons not practically acquainted with the subject, 1872–1874——It is desirable that the public should be made acquainted in what respect the lamp is favourable, and in what respect deficient, 1875.

[Second Examination.]—Manner in which a current of air may be raised in a mine sufficient to cause the Davy lamp to explode the external atmosphere, from the mode in which the coal is either wedged or blasted, 2941–2944——Preference given to a furnace at the bottom of the shaft over one at the top; cases in which the one at the top may be useful, 2949–2952.

[Third Examination.]—Rules to be attended to by workmen in Pendleton colliery; similar rules printed and delivered to miners generally would be useful, 3791, 3792.

Stephenson, Mr. His lamp contributed to reduce accidents, *Wilkinson* 285——His lamp is on a similar principle to Sir Humphrey Davy's; there is a dispute which has the priority, *Wilkinson* 285——Amount of reward to him for his discovery, *Buddle* 2422, 2423.

Stephenson's Lamp. Experiments which led witness to the construction of his lamp; its nature; period when first tried; comparison with that invented by Sir Humphrey Davy, *Stephenson* 1537–1551——The Killingworth mine is very inflammable, and there have been but few accidents therein since witness's lamp has been used, *Stephenson* 1552–1556——Construction of Stephenson's lamp, *Pereira* 4218–4223——Experiment tried with Stephenson's lamp, through which the flame passed, *Pereira* 4226–4228.

Stoppings. Description thereof, and purposes for which applied, *Buddle* 1988——Instances in which they are used in the Staffordshire mines, *Forrester* 2759, 2760——There is no better mode of forming stoppings than with bricks and lime, *Stephenson* 1609, 1610, *Roberts* 3380–3383, *Garforth* 3726, 3727——For partitions a brick stopping is better than a bratice, *Stephenson* 1669, 1661.——*See* also *Ventilation.*

Strata. The whole strata consists of alternate layers of sandstone and shale, *Wood* 847.

Street Gas. Comparison between street-gas and the carburetted hydrogen of mines, *Murray* 3273. 3280.

Suffocation. There are no marks on the bodies of men dying from suffocation; those dying from the explosion are shattered to pieces, *Elliott* 686–691——Danger from suffocation by the returning current of air after an explosion, and means taken by the miners to avoid it, *Clanny* 370, 371——Difficulty of applying, on the instant, a vessel mixed oxygen and atmospheric air to prevent suffocation, *Buddle* 2987–2993.

Sulphuretted Hydrogen. Effect of sulphuretted hydrogen, mixed with carbonic oxyde, in destroying human life before the candles indicate any danger, *Wood* 876–893, *Fife* 1448–1453, *Birkbeck* 3935——Its existence is possible in mines, *Buddle* 2502.
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Summer. See *Fire-damp.*

Sunday-schools. Most of the miners in Staffordshire can read since the establishment of Sunday-schools, *Smith* 3167.

Surgical Treatment. Where men have been eventually prevented from pursuing their employment it has generally been from want of proper surgical treatment, *Fife* 1402–1405.——*See* also *Medical Treatment.*

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Sussex, His Royal Highness the Duke of. See *Experiments.*

Swing-doors. Meaning of swing-doors, and manner in which they are constructed, and their use, *Buddle* 2301–2305.

Sykes' Local Records. The work printed by Mr. Sykes, of Newcastle, entitled Local Records, is a true record of melancholy facts, and may be printed as an appendix to the proceedings of the Committee, *Buddle* 2257–2262.——*See* also *Northern Mines.*

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Talc. Advantages of talc over glass for surrounding safety lamps, *Murray* 3306. 3314——Opinion against the use of talc instead of glass, *Birkbeck* 3914——The shield of talc in witness's lamp is a perfect security in any coal-mine, *Dillon* 4269.

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Timber. It cannot be used for support in working the thick seams by post and threil; it is always used in long work, *Smith* 3111–3115.

Tin Mines. The tin mines are perhaps the most healthy of all; they are not generally so deep in Cornwall as others, *Taylor* 275.

Tools. Men not allowed to carry tools or any thing ascending or descending, *Buddle* 3002. *See* also *Ascent and Descent of Miners.*

Topping. Manner in which the boys ascend and descend called topping, but through which few accidents arise, *Buddle* 2383–2386.

Trades' Union. Miners and potters are assisting each other in consequence of the union, *Forrester* 2793–2795——The trades' union among miners has seen its height, *Smith* 3086–3088——Pitmen are not employed at Ashton-under-Lyne if in the union, *Garforth* 3699——Among the miners would be sufficient to prevent the use of the lamp, if they were so inclined, *Forrester* 2747–2749.

Trap Doors. Have been all done away with, they used to be a great nuisance in mines, *Winship* 501——Different descriptions thereof in mines, *Buddle* 1988. *See* also *Children. Ventilation.*

Trap-Door Keepers. Their duties, *Johnson* 1322.

Truck System. Comforts of the miners much greater since the Act abolishing the truck system passed, *Clanny* 377, 379.

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Tube Boilers. Simple nature of their construction, *Gurney* 105.

Turner, Dr. Mode of the experiments by Dr. Turner weakened his previous confidence in the Davy lamp, *Upton* 1927–1931.——*See* also *Upton & Roberts' Lamp.*

Tyne Main. Instances of men being rendered insensible therein by sulphuretted hydrogen, *Wood* 880.

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Under-Viewer. His duty, *Johnson* 1322.

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United States. Manner in which the Nova Scotia coal competes with the British northern coal in the United States, *Smith* 3847, 3848.

Upton, George. (Analysis of his Evidence.)—Lamp manufacturer in Queen-street, Cheapside, 1876, 1877——Experiments tried upon Sir Humphrey Davy's lamp, by means of gas from a street pipe, showing under what circumstances the flame will pass through the gauze, 1878–1887——Further experiment by Mr. Pereira, but with similar results, 1888–1895——Nature of the lamp invented by witness, and Mr. Roberts's, showing its advantages over the Davy lamp, 1896–1913——Experiments tried by Mr. Pereira, on witness's lamp, with common coal gas, up to oxy-hydrogen, without exploding the surrounding atmosphere, except in the latter instance, 1914–1923——Mr. Partington's experiments on this lamp were not many, he appeared satisfied with the principle at once, 1924——Experiments by Mr. Hemming, which weakened his previous confidence in the Davy lamp, 1925–1927——Mode of the experiments by Dr. Turner, with similar results, 1927–1931——Experiments by Dr. Birkbeck, and other persons, of different institutions, with similar results, 1632——Effect of experiment tried on witness's lamp, with the carburetted hydrogen, as evolved in coal mines, at a mine near Dudley, 1933–1937——Meeting of mine owners at the gas works at West Bromwich, with experiments tried before them, 1937.

Danger from the use of Sir Humphrey Davy's lamp, and nature of the contingencies likely to affect witness's lamp, 1940–1942——Further examination upon the principle of witness's lamp, 1943–1946——Accidents that are now unaccounted for must be attributed to the carelessness of the miner, or derangement of the lamp, 1947–1949——Disadvantage of men sometimes using a lamp and sometimes a candle in the same part of the mine, 1950–1953——The Davy lamp is not much used in Staffordshire, it not giving sufficient light to work thick seams by, 1954–1959——Necessity for a perfectly safe lamp in the event of any interruption to the ventilation, 1960, 1961——Part of witness's lamp comes within a patent now in force, 1962–1965——Statement of the opinions of Dr. Turner and Mr. Pereira upon the safety of witness's lamp over the Davy lamp, 1966–1970——Opinion in favour of the efficacy of witness's lamp, being tried by scientific men previous to its being used in a mine, 1971–1978——Principle of witness's lamp may be adopted upon a larger scale than Sir Humphrey Davy's, and would then yield a better light, 1979–1981——A second glass is not advisable instead of the gauze, from fear of accidents, from the lamps getting into rough hands, 1982–1985——Price of witness's lamp will be moderate, 1986.

[Second Examination.]—Ignorance of coal owners and miners of the accidents to which the Davy lamp is liable, 3986, 3987——Unfair to the miners to attribute accidents of which no account can be given, to carelessness, when they might have occurred from the operation of a current of gas on the Davy lamp, 3988.

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No. 3.—(II.) Plan showing the Mode in which the Air from the Whole and Pillar Workings enters the Shaft.

No. 4.—(III.) Mode of Ventilating whole Coal-workings and taking off the Pillars.

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No. 7.—(VI.) Plan of Part of Killingworth Colliery Workings.

No. 8.—(1.) Diagram showing the Mode of Ventilating a Colliery by Shething.

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No. 11.—Plan of the Workings of the Bensham Seam, at the time of the Explosion on the 23 Oct. 1821.

No. 12.—A Thrust, after a District of Crypt Pillars incompletely wrought off.

No. 13.—Improved Plan of Working and Ventilating Coal Mines. By Mr. John Martin.

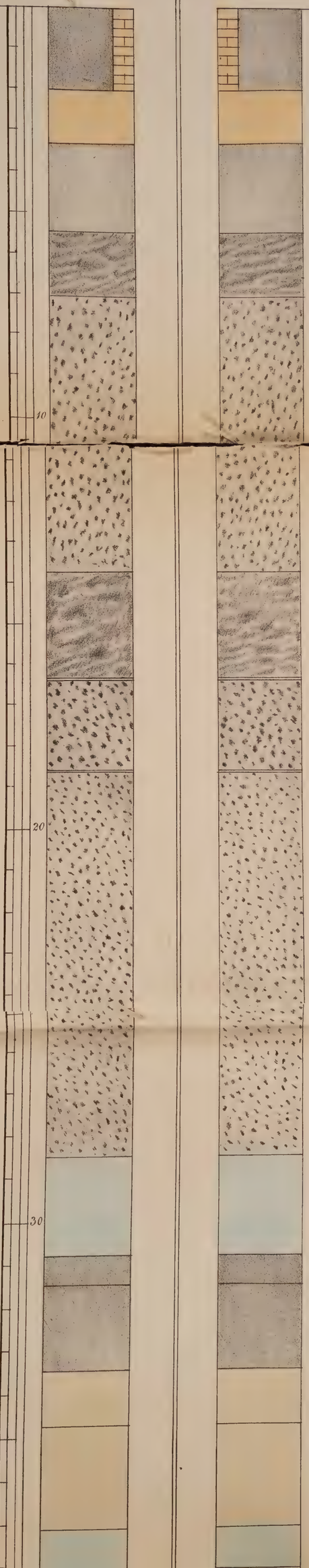
No. 14.—Plan, with Mr. John Martin's Opinion as to the Causes of Explosions in Mines, on the principle of Jarrow Colliery.

No. 15.—Safety Lamps: Davy's Lamp; Mr. John Martin's Safety Lamp.

N°. 1.

SECTION OF THE STRATA

Sunk through from the SURFACE to the THILL of the BENSHAM SEAM in the
G PIT; WALLS END COLLIERY.



NATURE of each STRATA — LOCAL NAMES	Fa.s	Ft.	In.	Fa.s	Ft.	In.s
Outset	2	.	.			
Yellow Clay	1	1	8			
Blue Clay	2	1	1			
Leavy Clay	1	3	3			
Stoney Clay	6	4	3			
Leavy Clay (strongly laminated)	2	3	9			
Sand (very irregular) wet	"	"	3			
Stoney Clay	2	1	2			
Sand (irregular) dry	.	.	3			
Stoney Clay	9	4	4			
				28	2	.
Blue Metal Stone	2	2	"			
Grey Post	.	4	"			
Grey Metal Stone	2	.	.			
White Post	1	1	7			
White Post with Water	2	2	"			
Blue Metal	.	5	10			

MEMORANDUM

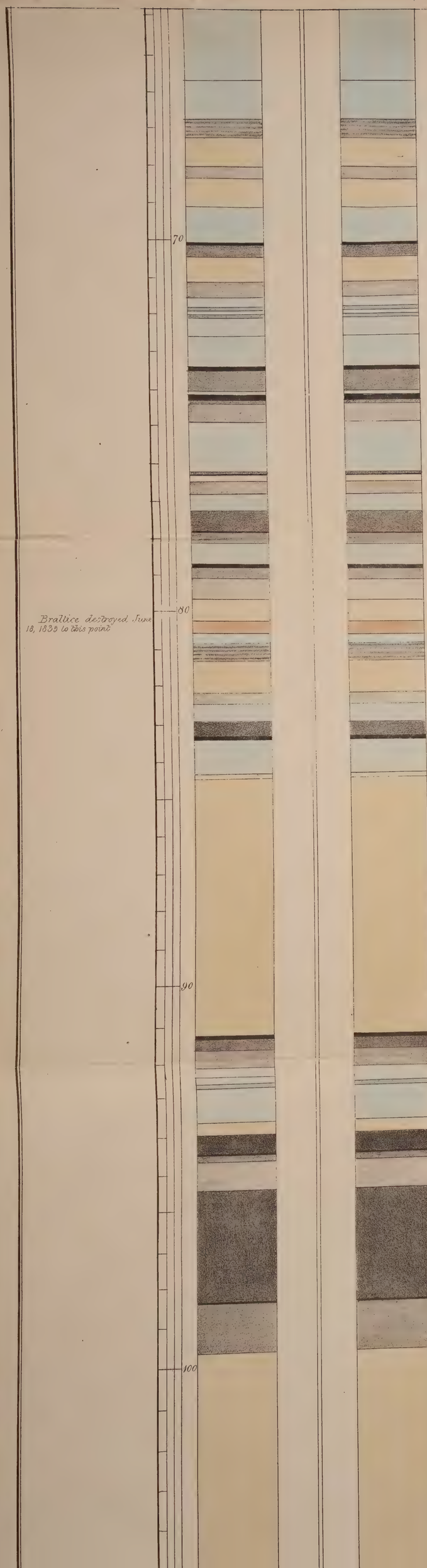
Grey & White Post — Siliceous Sandstone. Metal Stone - Argillaceous.

White Post, wet	1	4	7			
Blue Metal Parting	"	1	"			
White Post	2	1	2			
Grey Metal	"	"	8			
White Post	1	1	4			
Grey Scalmy Post	"	"	9			
White Post	1	1	9			
COAL	"	"	5			
Thill	1	3	"	16	5	9
Post Girdles & Metal Partings	1	"	9			
Blue Metal	"	1	8			
Thill	"	"	8			
Grey Post	1	1	2			
Blue Metal	1	4	3			
COAL	"	"	9			
White Post	1	1	"	6	"	3
Cash Parting with Water	"	"	3			
White Post	1	2	10			
Grey Metal	3	1	5			
Blue Metal	1	"	6			
COAL	"	"	2			
Thill	"	1	2			
COAL	"	1	2			
Thill	"	1	10			
White Post	"	3	"			
Grey Metal	"	"	6			
White Post	"	"	6			
White Post	1	3	4			
Black Metal	"	"	2			
Thill	"	2	1			
Blue Metal	"	3	11			
COAL	"	"	4			
Thill	"	4	2			
Grey Metal		5	10			

603.

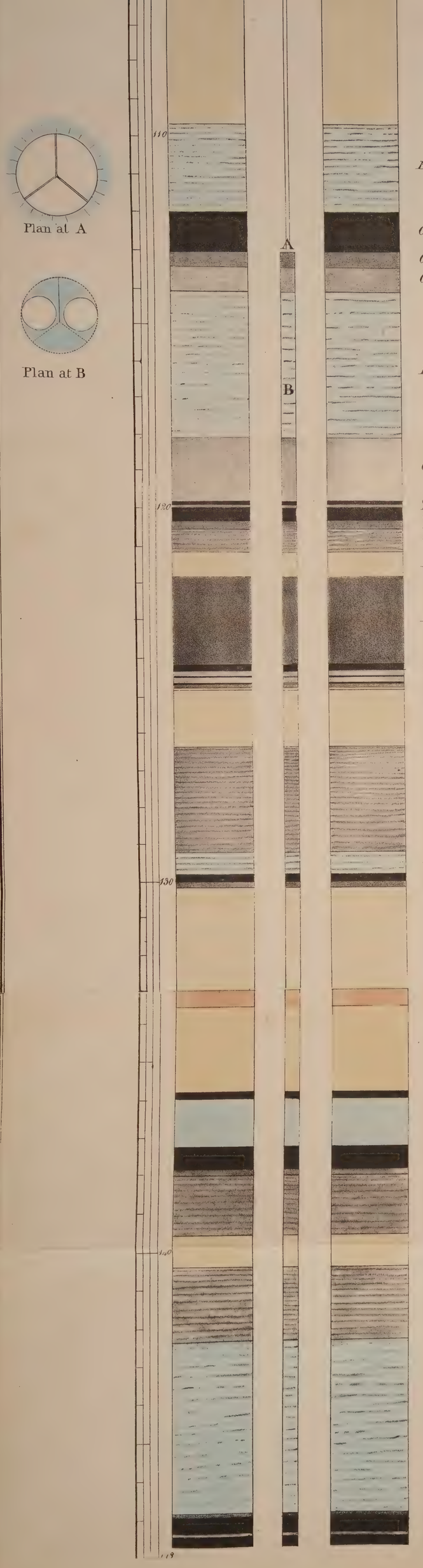
Ordered, by the House of Commons, to be Printed 4th Sept. 1855.

James & Luke G. Hansard & Sons Printers. J. Basire lith.



Brattice destroyed June 18, 1838 to this point

Blue Metal	1	5	-			
Blue Metal	1	-	6			
Grey Post with Girdles	"	3	"			
White Post	"	5	"			
Grey Mixed Post	"	2	-			
White Post	"	4	8			
Blue Metal	"	5	9			
COAL	-	-	4	18	4	9
Thill	-	2	-			
White Post	"	4	3			
Grey Post	"	2	6			
Blue Metal	"	1	5			
Post Girdles	"	"	5			
Blue Metal	"	"	10			
Post Girdle	"	"	3			
Blue Metal to a Parting	"	3	"			
Blue Metal	-	4	11			
COAL	-	1	-			
Thill	"	3	"	3	2	7
Blue Metal — THREE QUARTER COAL	-	-	9			
COAL	"	"	10	-	4	7
Thill	"	-	6			
Grey Metal	"	3	"			
Blue Metal	1	2	1			
Black Metal	"	-	3			
White Post	-	1	-	1	5	11
Grey Scalmy Post	"	2	2			
Blue Metal	"	2	7			
Black Metal	"	3	4			
COAL	"	-	1	1	3	2
Thill	-	2	-			
Blue Metal	-	3	5			
COAL	-	-	6		5	9
Thill	-	2	-			
Grey Metal	-	3	3			
Scalmy Post	"	3	6			
Whin Girdle	-	2	"			
Blue Metal	"	1	6			
Grey Post with Girdles	-	3	-			
White Post	"	5	"			
Grey Mixed Post	"	2	"			
Blue Metal	"	2	7			
Black Metal	-	2	5			
Splint COAL	"	"	8	4	3	11
Blue Metal	-	5	4			
White Post Girdle	"	-	11			
White Post	6	4	9			
COAL	"	-	7	7	5	7
Thill	"	1	6			
Grey Post Girdles	-	3	1			
Blue Metal	"	2	9			
Grey Post Girdle	"	"	9			
Blue Metal	-	5	5			
Post Girdle	"	2	-			
Black Metal	"	3	2			
COAL	-	-	1½	3	-	9½
Thill	"	1	-			
Grey Metal Girdles	"	4	4			
Black Metal or Black Stone	2	5	5			
COAL	-	-	1½	3	4	10½
Thill	1	1	6			
Main Post	10	"	7			



Blue Metal with Girdles	2	2	"			
COAL—HIGH MAIN COAL SEAM	1	"	7½	14	4	8½
Ground COAL	"	2	2	113	"	7½
Grey Thill	"	3	10			
Blue Stone with Whin Girdles	4		2			
Grey Metal Stone	1	4	4	6	4	6
COAL / *Band* / *COAL* — METAL COAL SEAM	"	"	6			
	"	"	6			
	"	2	6			
Thill	"	1	6	"	3	6
Grey Metal mixed with Iron Stone Girdles	"	3	4			
Post Girdles	"	4	"			
Black Metal	2	1	7			
COAL	"	"	10			
Grey Metal Stone	"	"	10			
COAL	"	"	8			
Grey Metal Stone	"	"	10			
COAL	"	"	8			
Thill	"	"	10			
White Post	"	"	6			
White Post	1	4	8			
Grey Metal mixed with Whin Girdles	2	4	"			
Blue mixed with Iron Stone Girdles	"	3	6			
COAL—STONE COAL	"	1	4	9	4	2
Thill	"	1	"			
White Post	"	2	5			
Whin	"	2	5			
White Post	2	1	6			
COAL and Stone mixed	"	"	11			
Blue Metal mixed with Iron-Stone Girdles	1	1	9			
COAL YARD COAL SEAM	"	3	6½	7	4	1½
Thill	"	1	"			
Grey Metal mixed with Iron Stone Girdles	1	3	4			
White Post	"	5	4			
Grey Metal mixed with Whin Girdles	2	"	"			
Blue Metal mixed with Iron Stone Girdles	4	2	5			
Black Metal	"	"	3½			
Crow COAL	"	2	2	9	"	4½
Top COAL	"	2	2			
Splint and Stone	"	1	6			
Bottom COAL — BENSHAM SEAM	"	1	5	"	4	9
				147	4	0½

603. Ordered by the House of Commons to be Printed 4th Sept. 1849.

N° 2.

SECTION OF THE STRATA

SUNK and BORED through from the BENSHAM SEAM

in a STAPLE about 25 YARDS WEST of the

A PIT; WALLS END COLLIERY.

Thill mixed with Iron Stone	1	1	5			
Whin	..	2	..			
Grey Metal and Post Girdles	1	2	..			
COAL	..	..	3	2	5	8
Grey Metal and Post Girdles	5	1	..	5	1	..
Splint COAL	..	..	8			
Grey Metal Stone	..	1	8			
COAL	..	..	6			
Stone	..	..	1½			
Good COAL	..	1	3	..	4	1½
Thill	..	1	..			
Grey Metal and Post Girdles	..	3	11			
Whin	..	2	6			
Grey Metal	1	..	7			
Whin	..	1	3			
Grey Metal	1	2	9			
Blue Metal	1	2	6			
Black Metal	..	2	10	5	5	4
COAL	..	2	2			
Grey Stone	..	2	8			
Splint COAL	..	..	1			
Grey Stone	..	..	1½			
COAL	..	..	1½	1	1	0½
Thill	..	1	6			
Grey Metal	..	1	6			
Post Girdles, with Blue Metal Partings	3	5	6			
Blue Metal	1	5	6			
Black Metal	..	..	9	6	2	9
COAL	..	1	9			
Band	..	..	1			
COAL	..	..	3			
Band	..	2	5	..	5	6
COAL						
White Thill	..	5	8			

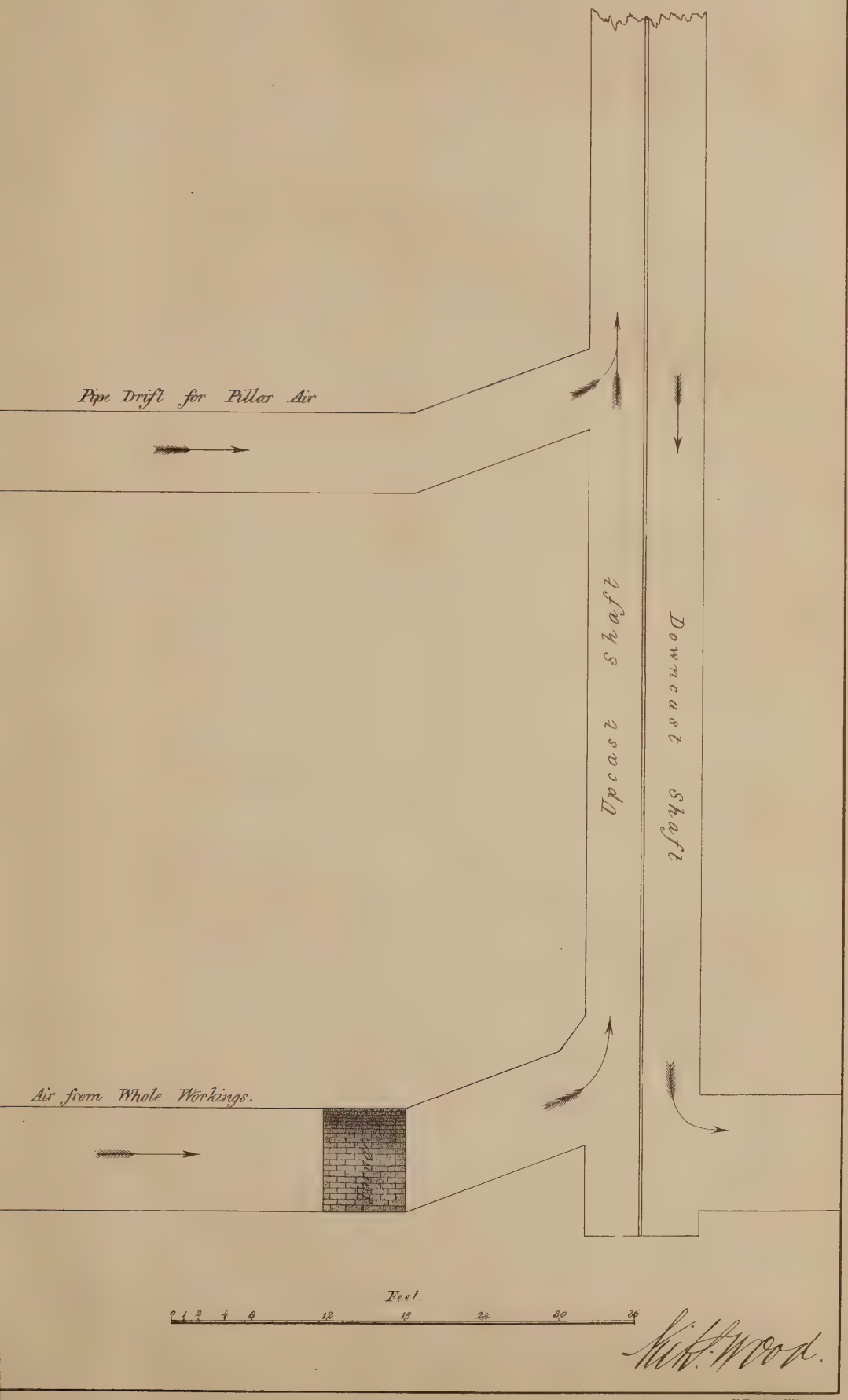
LOW MAIN COAL SEAM

Grey Scalmy Post		"	5	"		
White Post		"	2	"		
Grey Metal		"	3	2		
White Post		"	5	"		
Grey Post		1	3	"		
White Post		2	2	8		
Blue Metal mixed with Post Girdles		"	5	"		
White Post		"	4	11		
Blue Metal		"	"	7		
COAL		"	"	16		
Grey Thill		"	1	6	10	1	5
Grey Metal		"	1	6			
Blue Metal		"	3	2			
Grey Whin		"	"	6			
Blue Metal		"	2	"			
White Post		"	1	4			
Blue Metal		"	1	"			
White Post		"	"	6			
Whin		"	1	3			
White Post		"	1	7			
Blue Metal		"	1	1			
White Post		"	2	8			
Grey Whin		"	1	"			
White Post		"	1	"			
Blue Metal mixed with Iron-stone Girdles		6	"	3			
COAL		"	"	5			
Blue Metal		"	"	4	9	2	2
White Post		"	"	7			
Grey Post		1	2	8½			
Blue Metal		"	1	3½			
Black Metal		"	"	10½			
Grey Metal		"	"	4½			
Blue Metal		"	4	7	2	4	9
COAL		"	2	11			
Grey Stone	BEAUMONT SEAM	"	"	4			
COAL		"	"	7½			
Grey Stone		"	1	3			
COAL		"	1	5	1	"	6
Thill		"	2	"			
Grey Metal mixed with Post Girdles		1	3	7			
Black Metal		"	2	7			
Grey Post		"	"	8			
White Post		1	3	3			
COAL		"	"	7			
Thill		"	"	10	4	"	8
Grey Metal mixed with Post Girdles		1	2	3			
Blue Metal		"	3	"			
COAL		"	1	"			
Thill		"	1	11	2	1	1
Blue Metal		1	"	"			
COAL		"	"	5			
Thill		"	2	"	1	2	4
Grey Post		"	1	4			
Grey Metal		"	1	8			
White Post		"	3	1	1	2	1
					55	4	5

603 Ordered by the House of Commons to be Printed, 4th Sept.r 1885
James W. Locke & Bernard & Sons Printers
J. Basire lithog.

No. II.

Plan shewing the mode in which the Air from the Whole and Pillar Workings enters the Shaft.



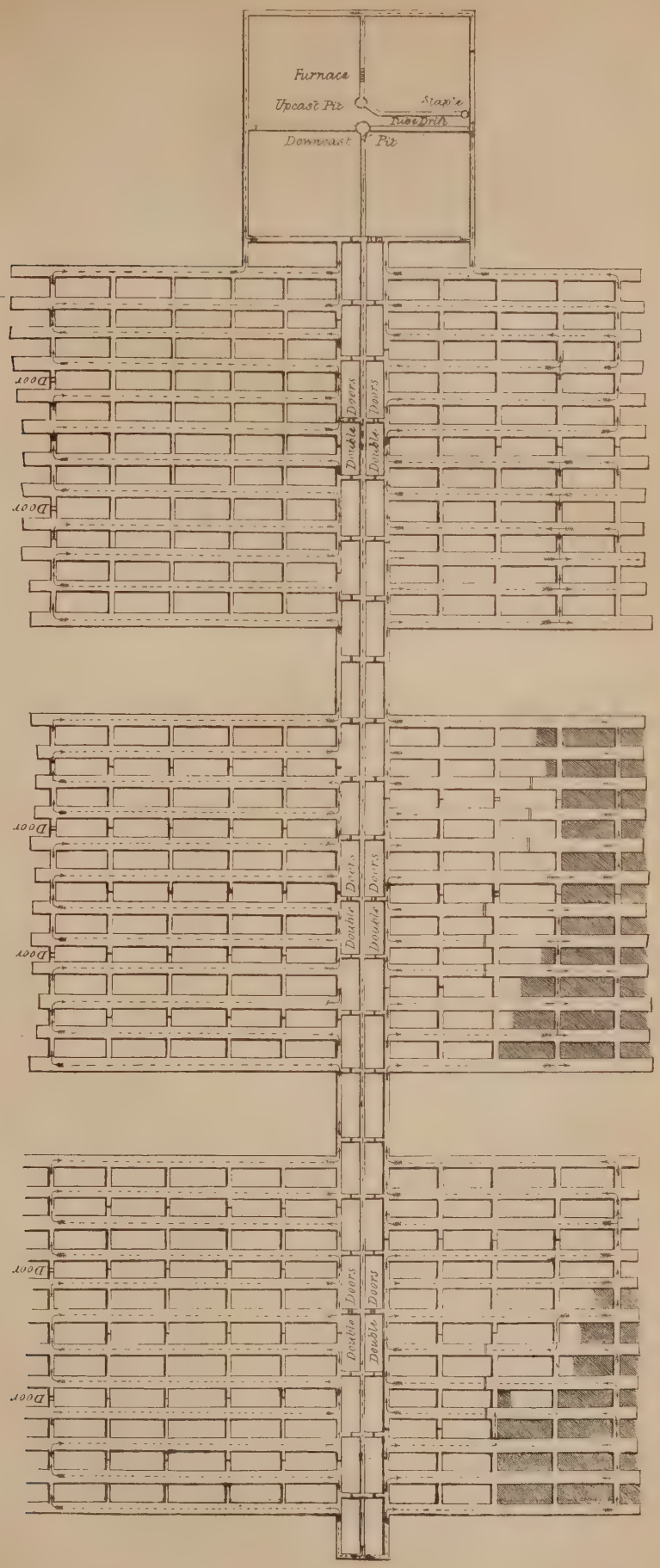
W. H. Wood.

J. Basire lithog.
James & Luke G. Hansard & Sons. Printers.

603. Ordered by the House of Commons to be Printed 4th Sept. 1835.

N°. III.

MODE of VENTILATING WHOLE COAL WORKINGS
and taking off the Pillars.

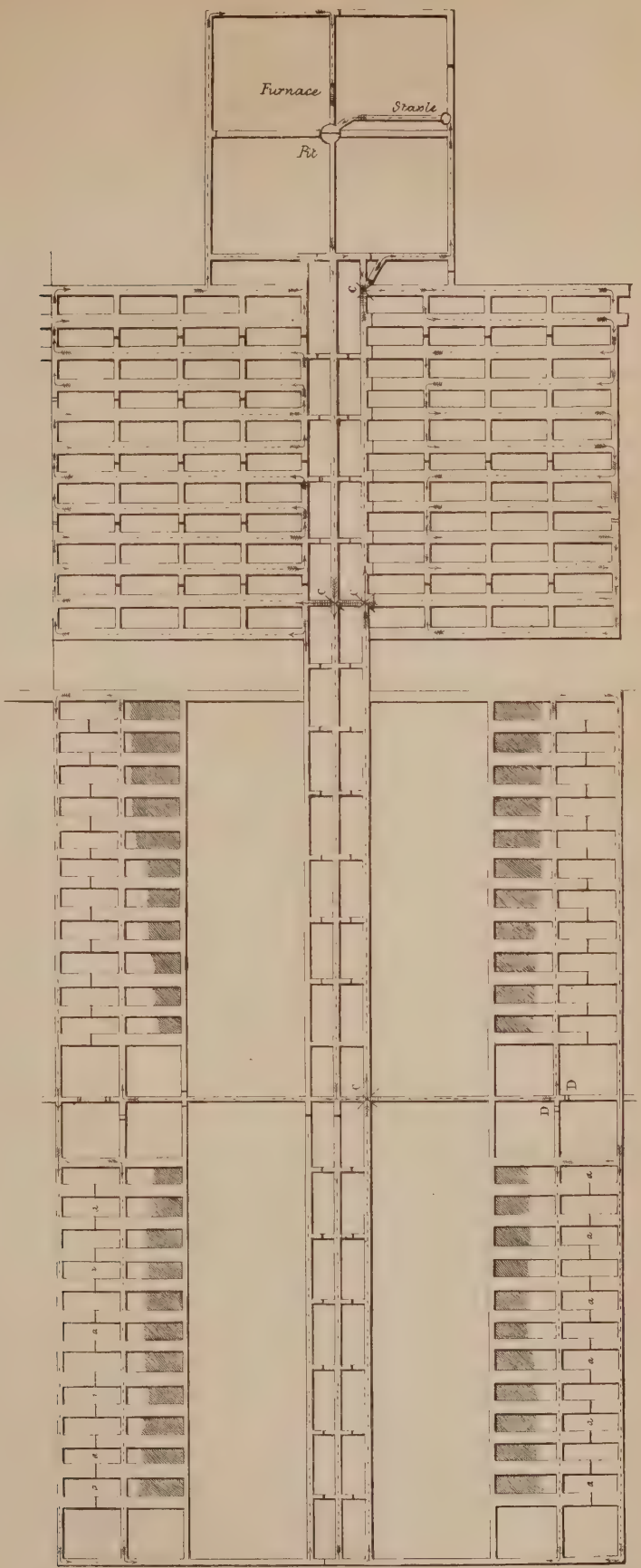


603. Ordered by the House of Commons to be Printed 4th Sept. 1835.
James & Luke Hansard & Sons, Printers.

N°. IV.

MODE of VENTILATING WORKINGS

Where Whole and Pillars are worked in the same Operation.



J. Basire lithog

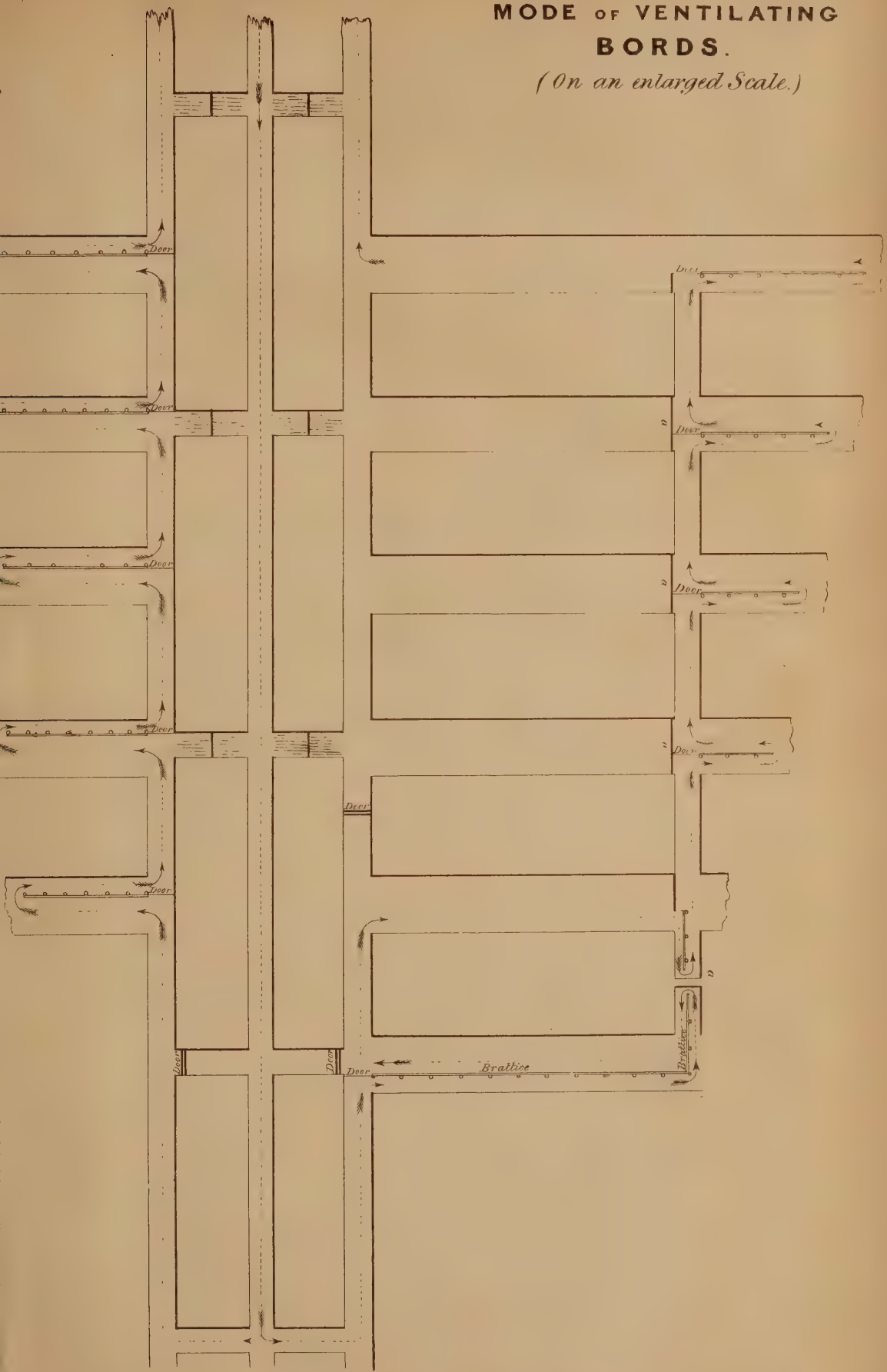
603. Ordered by the House of Commons to be Printed 4th Sept. 1835.

James & Luke G. Hansard & Sons Printers.

N°. V.

MODE OF VENTILATING BORDS.

(On an enlarged Scale.)



N. K. Wood.

J. Basire lithog.

603 Ordered by the House of Commons to be Printed 1855.

James & Luke G. Hansard & Sons, Printers.

(N°VI.)

PLAN OF PART OF

KILLINGWORTH COLLIERY WORKINGS.

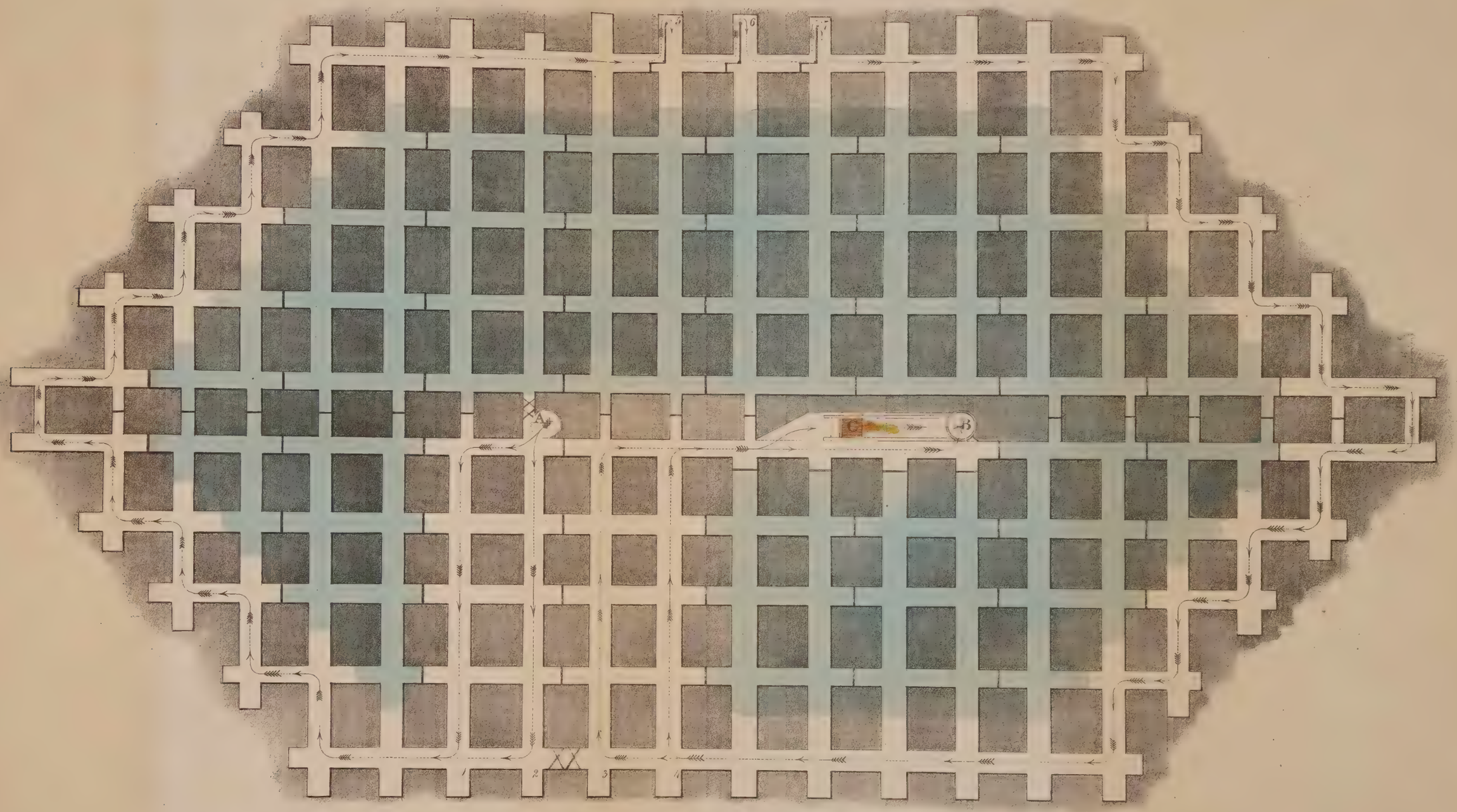
603. Ordered by the House of Commons to be Printed, 4th Sept. 1835.
James & Luke G. Hansard & Son

N. S.

No. 1.

DIAGRAM,

Shewing the Mode of Ventilating a Colliery by Shething.



A. *the down-cast*; B. *the up-cast Pit*; C, *the Furnace. The Darts shew the direction of the Current of Air.*
In this case the Current of Air is only thrown round by the Face, or extremities of the Workings. the interior, or Waste, remaining unventilated, technically called dead, as represented by the Blue Shade.

505. Ordered by the House of Commons to be Printed 4th Sept. 1835.

J. Basire lithog

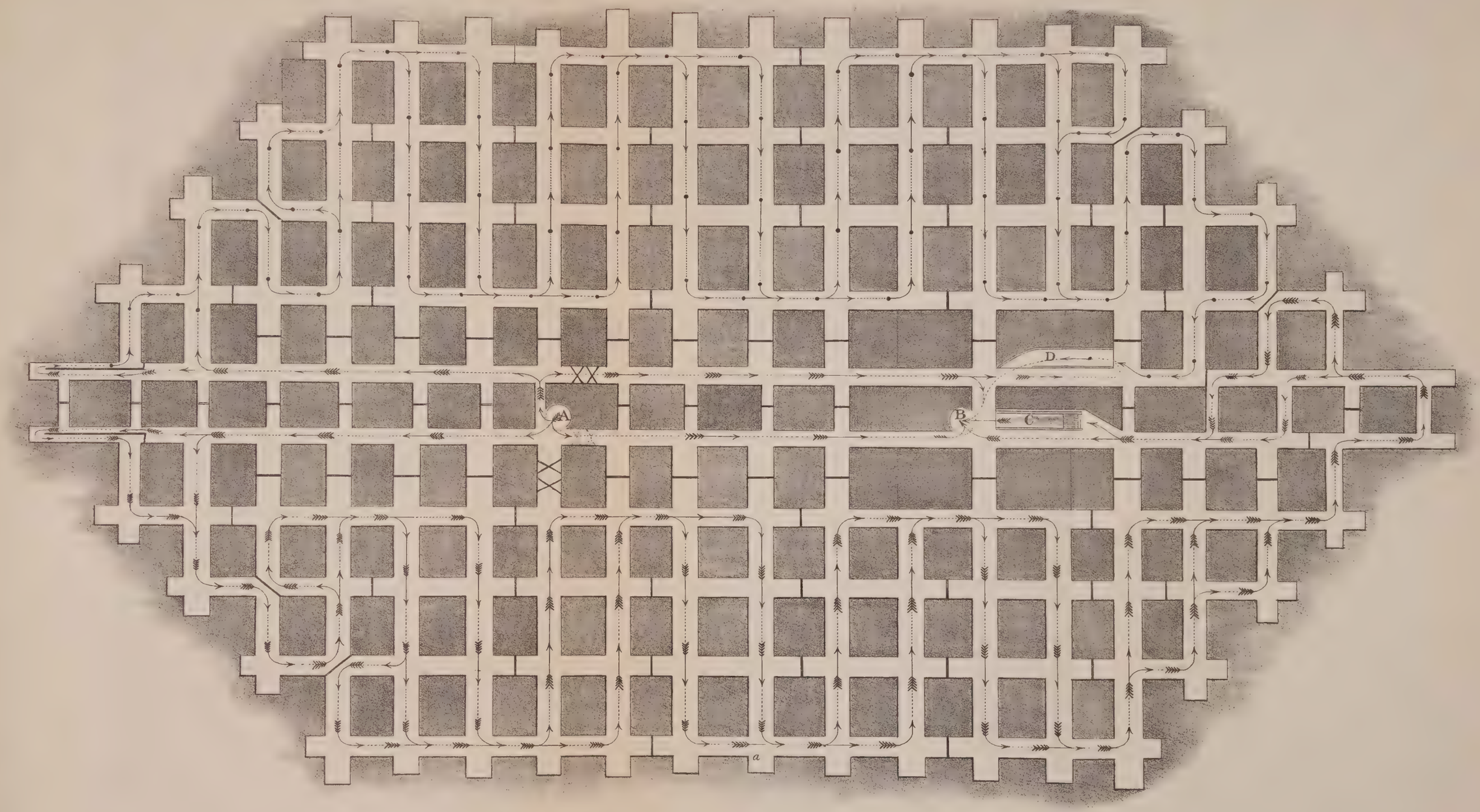
James E. Luke & Hansard & Sons Printers

E
W

N.° 2.

DIAGRAM

Shewing the Mode of Ventilating a Colliery
By *Coursing* the Air.



A, *the Down-cast*; B, *the up-cast Pit*; C, *the Working Furnace*; D, *the Cold, or Dumb Furnace*.

By this mode every part of the Waste as well as the Working places are ventilated. The Darts shew the direction of the Current of Air.

The Column of Air, after descending the Shaft, is divided, or split, at the bottom, into two Currents, the one ventilating the Western, the other the Eastern District of the Workings.

The Western District is supposed to discharge so much inflammable Air as to render the circulating Current explosive; it is therefore discharged into the up-cast Shaft, through the Dumb Furnace D, *as represented by* •——➤

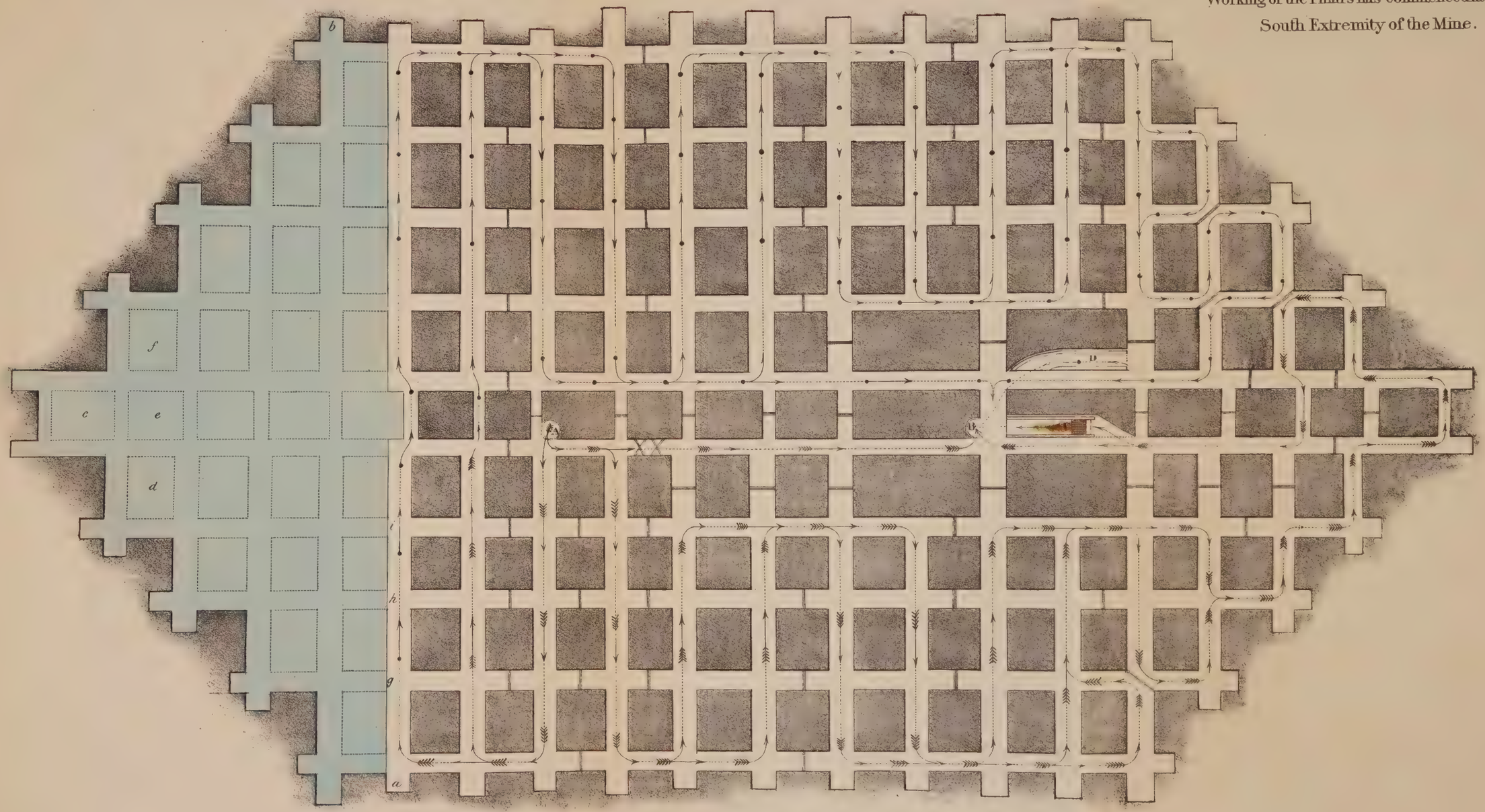
The other Current passes through the Eastern Division, which is supposed not to discharge so much inflammable Air as to load the circulating Current to the firing point, and is carried to the upcast Shaft, as shewn by ➤——➤.

603. Ordered by the House of Commons to be Printed Sept.r 4th 1835. J Bastre lithog.
James & Luke & Hansard & Sons Printers.

N°. 3.

DIAGRAM

Shewing the Ventilation the same as N°. 2, but after the Working of the Pillars has commenced at the South Extremity of the Mine.



It will be seen by this that the taking away of the Pillars destroys the means of ventilating that part of the Mine, consequently, it (the Goaf, as it is technically called,) becomes a gasometer of daily increasing size, as the pillars are daily worked off, and is always ready to pour its contents into the adjoining current of Air, to be carried through the dumb Furnace up the upcast Shaft.

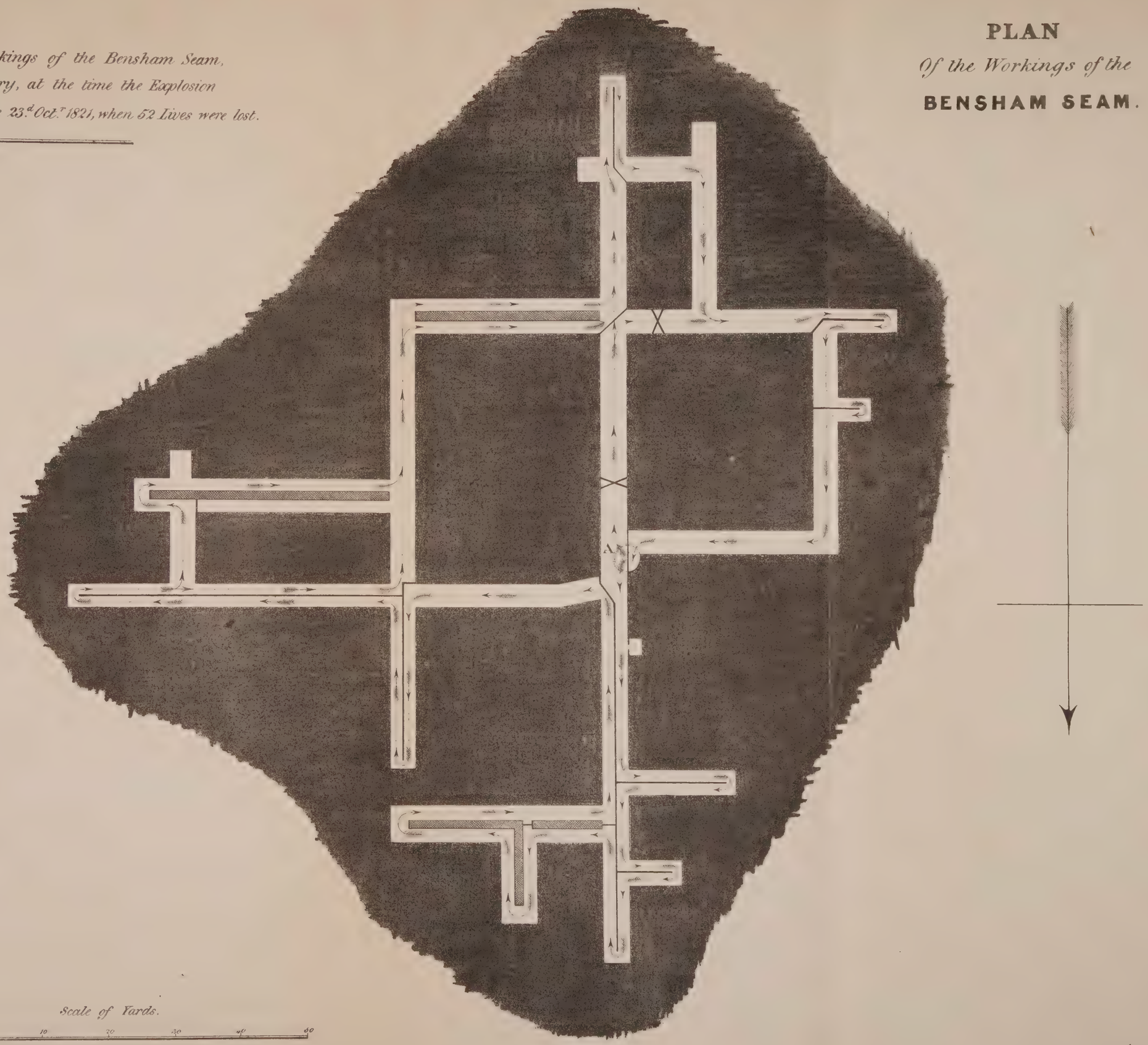
Ordered by the House of Commons to be Printed 4th Sept. 1835.
J. Basire lithog.
James & Luke G. Hansard & Sons Printers

Plan of the Workings of the Bensham Seam, Walls-end Colliery, at the time the Explosion happened on the 23.d Oct.r 1821, when 52 Lives were lost.

PLAN

Of the Workings of the

BENSHAM SEAM.



Scale of Yards.

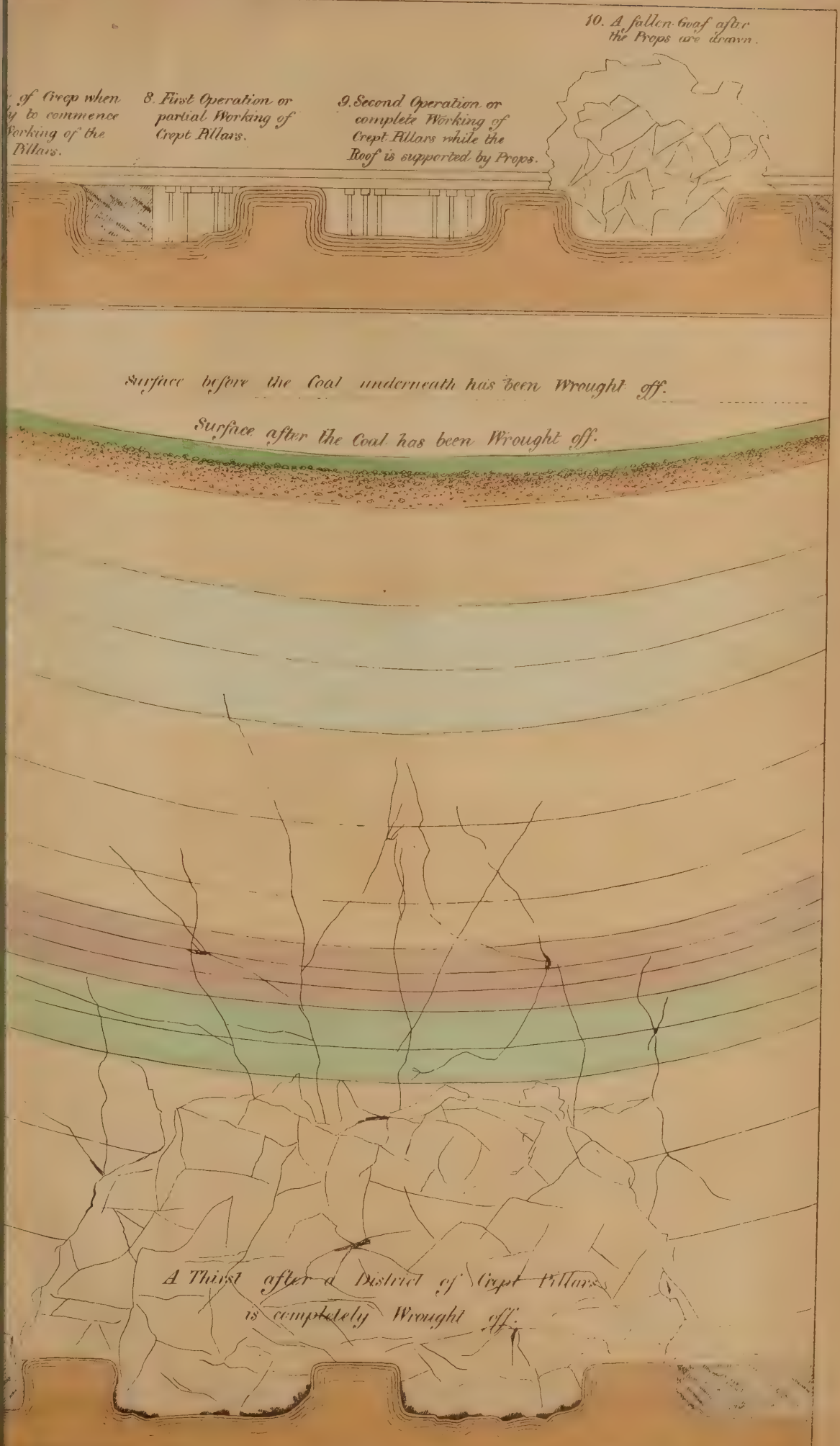
0 5 9 10 20 30 40 60

Nich.s Wood.

603. Ordered by the House of Commons to be Printed 4.th Sep.r 1835.

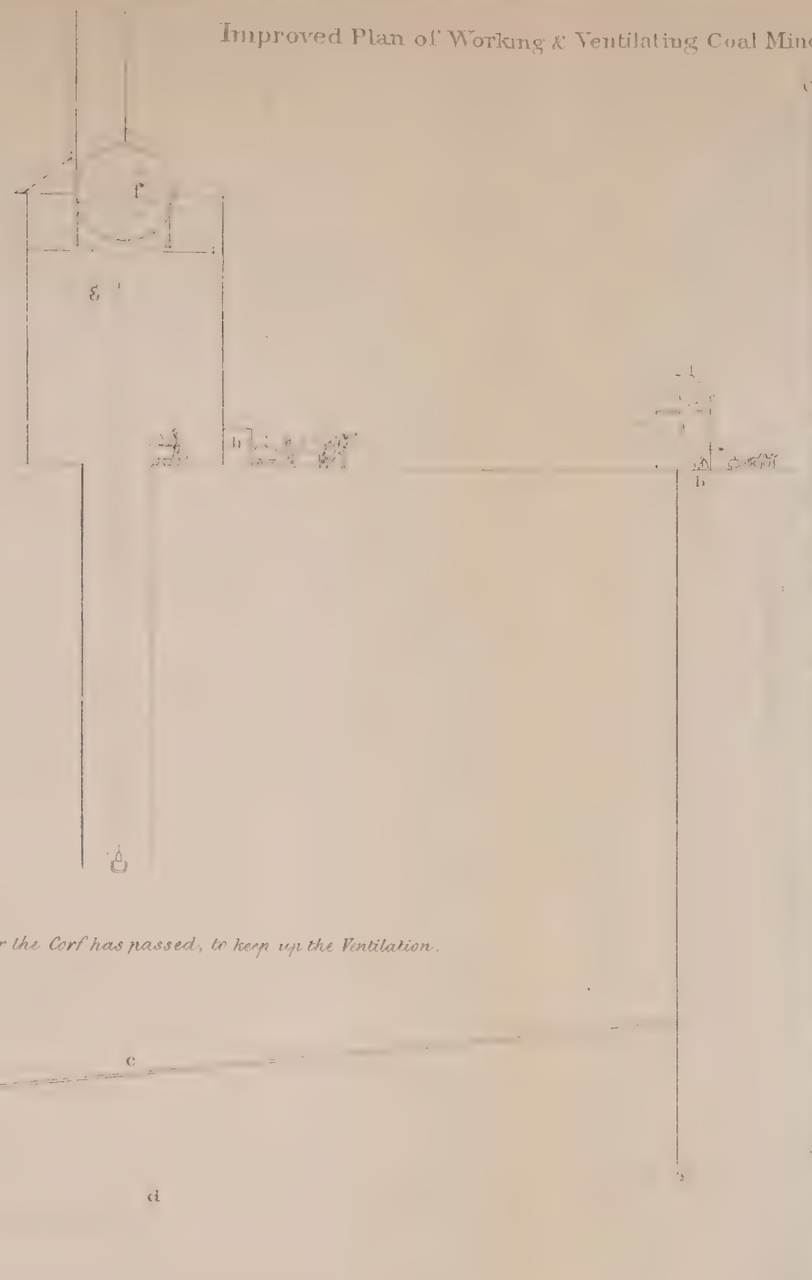
J. Basire lithog.

James & Luke G. Hansard & Sons, Printers.

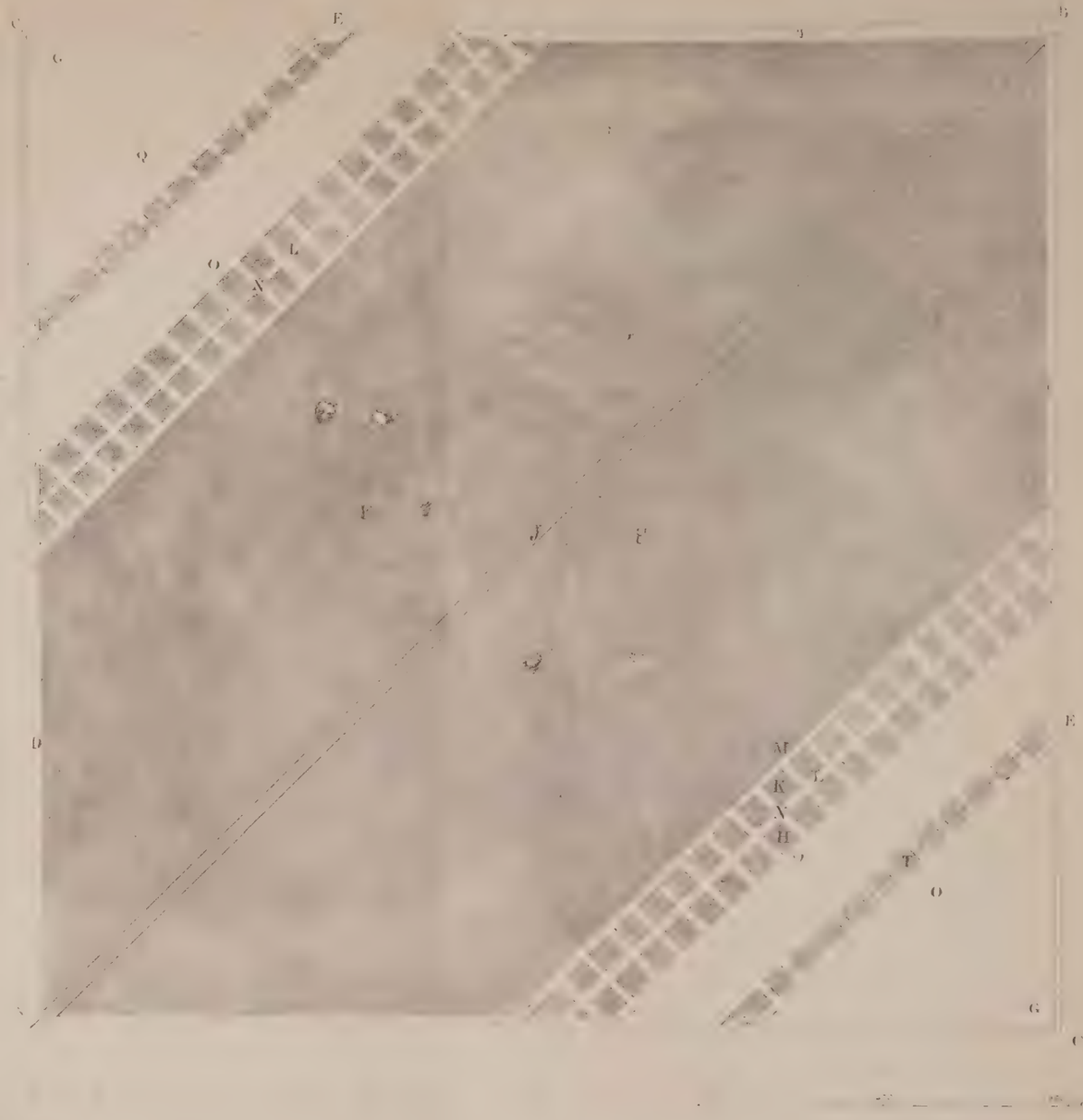

10. A fallen Goaf after the Props are drawn.
of Creep when
y to commence
Working of the
Pillars.
8. First Operation or partial Working of Crept Pillars.
9. Second Operation or complete Working of Crept Pillars while the Roof is supported by Props.
Surface before the Coal underneath has been Wrought off.
Surface after the Coal has been Wrought off.
A Thirst after a District of Crept Pillars is completely Wrought off.

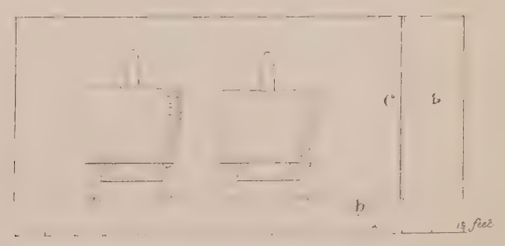
Ordered by the House of Commons to be Printed 1835.

Improved Plan of Working & Ventilating Coal Mines. By John Martin. 30. Alsop Terrace. New Road. London June 22nd 1835.



a. *The Downshaft and Pumps.*
b. *The Upshaft and Ventilator.*
c. *The Well.*
d. *The Coal Seam.*
e. *An upper Coal Seam.*
f *The Ventilating Fan.*
g. *The Rope and Wheel.*
h. *The Doors to close immediately after the Corf has passed, to keep up the Ventilation.*





Transverse Section of the Headway or Gallery.

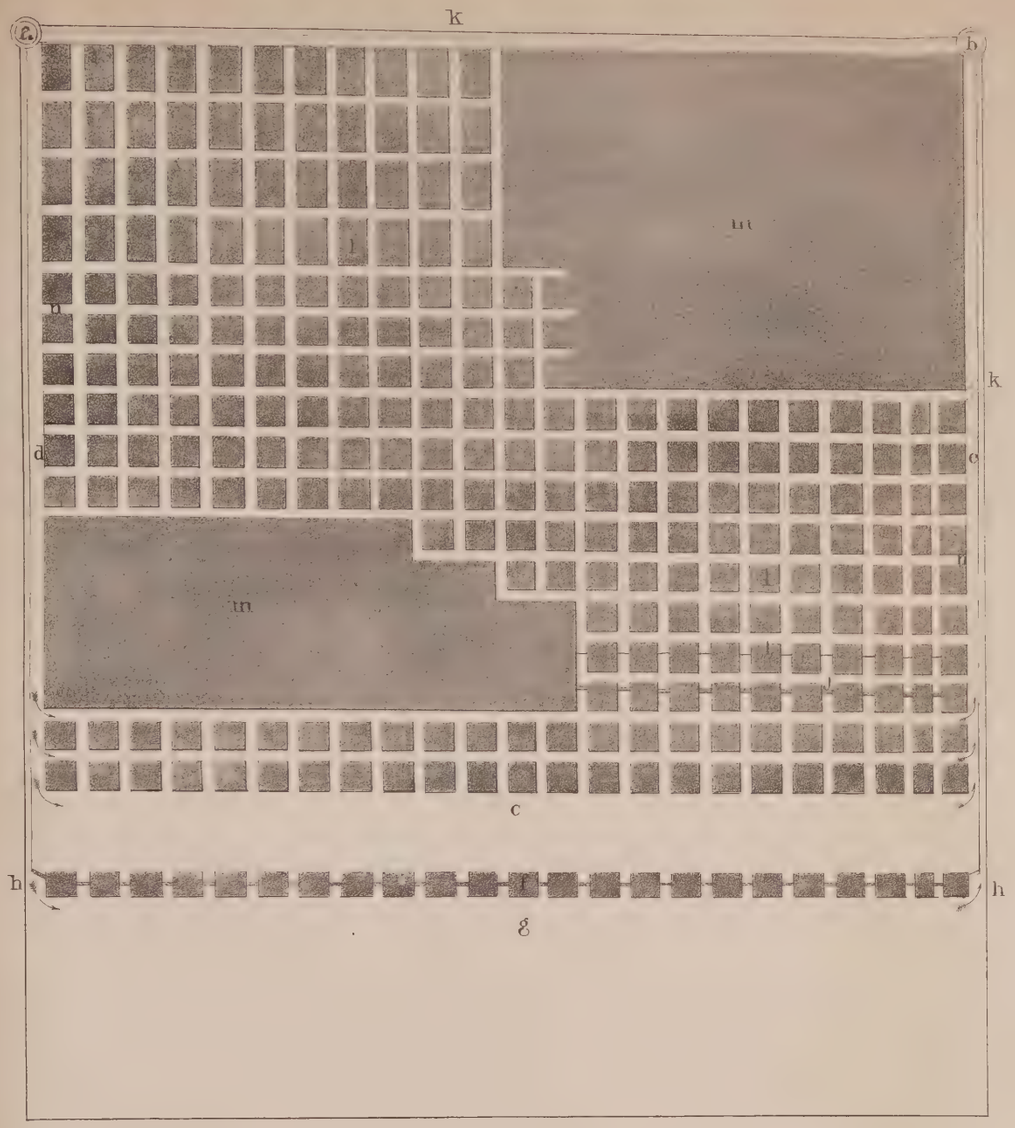
a, *Ventilating Passage to the forming of the Gallery.*

b, *Drain.*

c. *Bricked sides of the Headways. which would have the advantage of preventing the oozing of the gas from the coal, and the outer side being left standing, would serve as a warning of an old Mine, so that no accident could in future occur from opening into old workings.*

A. *The Downshaft* } *These should be bratticed so as to answer the purposes of two shafts when the Ventilation Galleries are completed.*
B *The Upshaft* }
C. *The Angles where the headways from the two Shafts meet.*
D, *The Downcast Headways, with ventilating Passages running by the sides and parallel with the Headways, which passages serve the purposes of ventilating the headways during their formation, & more particularly that of ventilating the Goaf behind the Works.*
E, *The Upcast Headway, similar in principle to the Downcast,* D.
F, *The field of unworked Coal.* G, *The angle where the mining commences after the Headways are formed.* K, *New Pillars.* J, *A line of Coal, which should be left at the completion of the Works.* H, *Pillars of coal in a line to protect the Tramway, and should not be worked out till a new and similar line of Pillars is nearly finished.*
L, *The existing Tramway.* M, *The new Tramway in a state of formation.*
N, *Fixed lamps, which light the Tramway and other parts of the Works.*
O, *Dots representing wooden Props, to protect the men working at the Pillars,* K.
P *Angular Reflectors, which receive light from the Lamps,* N, *and reflect behind the Works*
Q *The fallen Roof, after the whole of the Coal has been worked away.*
R, *A method of conveying the coals to the Shaft.*
S, *Regulating Ventilator, with Tubes.*
T. *A line of Coal Pillars, with strong brick Stoppings, to separate the Goaf from the Works.*

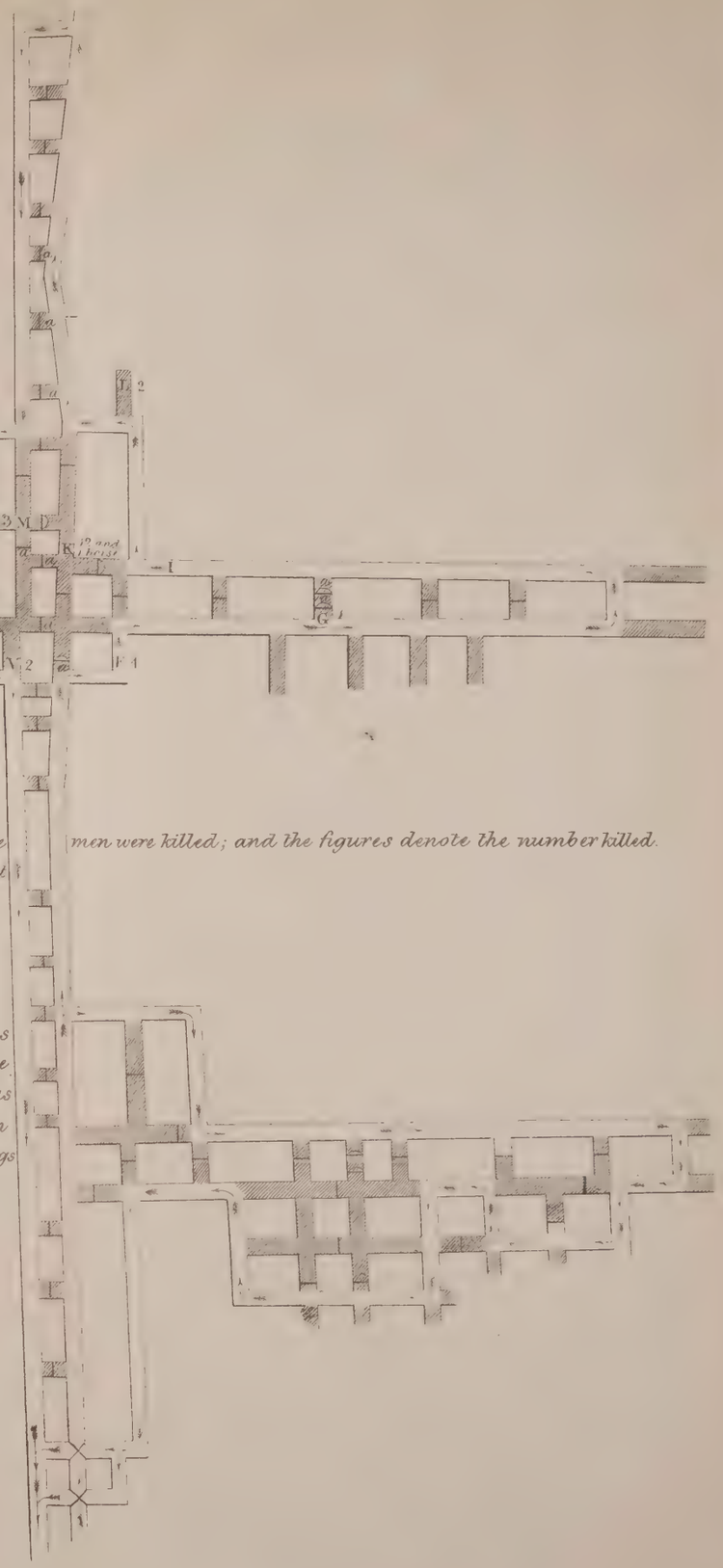
Ordered by the House of Commons to be Printed 4th Sept. 1835.
James & Luke G. Hansard & Sons Printers.



How to apply M^r John Martin's new principle of working and ventilating Coal Mines to old Works, June 22, 1836.

a, *Downshaft.*
b, *Upshaft.*
c, *Face of the Works.*
d, *Downshaft Railway*
e, *Upshaft d°*
f, *A line of Coal Pillars, with strong stoppings of brick, to separate the Goaf from the Works.*
g, *The Goaf.*
h, *The ventilating Passage by which the Gas is drawn from the Goaf.*
j, *The Stoppings which separate the old workings from the new.*
k, *The means of drawing off the Gas from the old works.*
l, *The old works.*
m, *The Coal which has not yet been worked*
n, *Air-tight Stoppings of brickwork.*

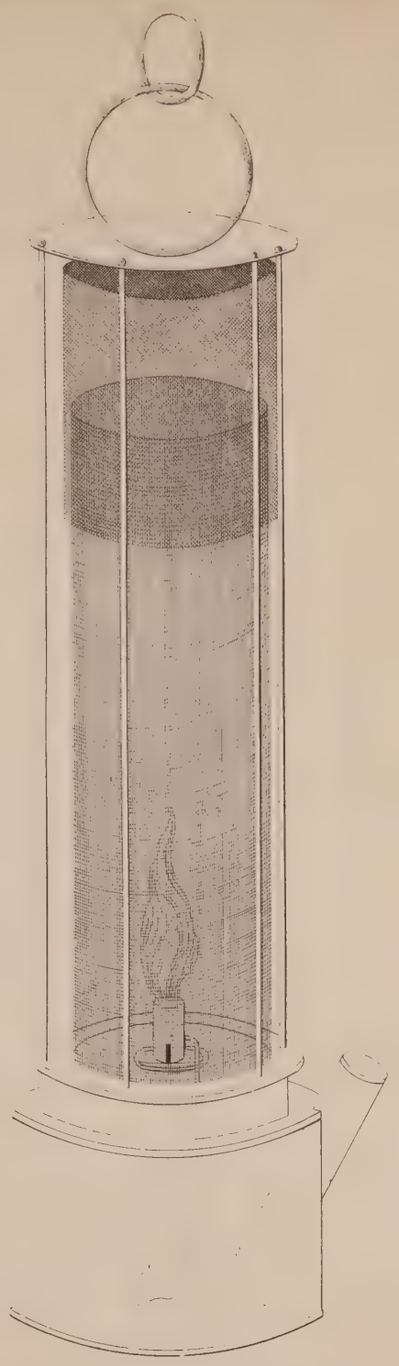
Plan with M^r John Martin's Opinion as to the Causes of Explosions in Mines, on the Principle of Jarrow Colliery.



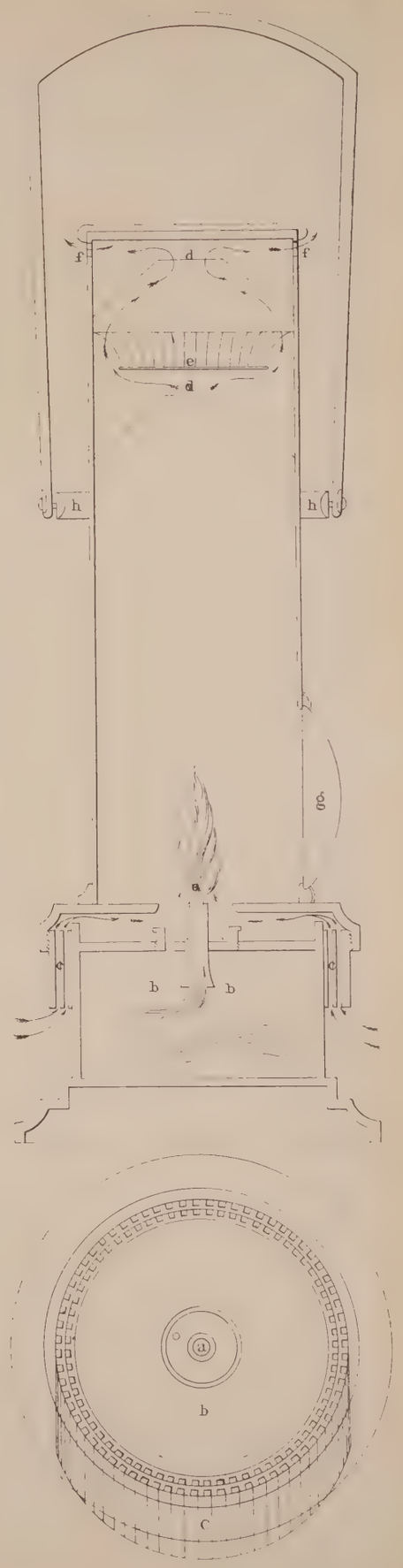
The Roman letters show the places where the men were killed; and the figures denote the number killed.

a, The Doors & Stoppings that were blown out
I, The Stoppings.
D, The Doors.
The Crossings.
The Current of the Air.
Rectangular recesses where the foul gas accumulates; which are consequently liable to explosions of the most fatal character, as is evident by the great destruction of life in those places, and by the doors and stoppings being blown away.

Ordered by the House of Commons to be Printed 4th Sept.r 1835.
J. Basire lith.
James & Luke G. Hansard & Sons Printers.



Davy's Lamp.



Mr. John Martin's
SAFETY LAMP.

being a suggested improvement on Mr. W. Martin's Lamp.

a. *The Wick which should never be raised so high as to cause the flame to smoke.*

b. *Oil Chamber.*

c. *Grooved Cylinders which will only allow the passage of so much air as is just sufficient to support the flame. The advantage of the grooves or tubes over wire-gauze or thin perforated plates is that the air has to pass through a body of metal; a principle which is acknowledged by the scientific to be safe.*

d. *Copper top with an opening of the same size as that round the flame.*

e. *The break.*

f. *The places where the heated air escapes & through which the foul gas cannot enter.*

g. *Lens to cast the light into those parts where the air is so foul as to cause the lamp to go out.*

h. *Method of suspending the lamp which has the principle of the universal joint.*

August 1st 1835
30, Allsop Terrace, New Road.
London.

603. Ordered by the House of Commons to be Printed 4th Sept. 1835.

James & Luke G. Hansard & Sons, Printers

REPORT

FROM

SELECT COMMITTEE

ON

ARTS AND MANUFACTURES:

TOGETHER WITH

THE MINUTES OF EVIDENCE,

AND APPENDIX.

Ordered, by The House of Commons, *to be Printed,*
4 *September* 1835.

Martis, 14° die Julii, 1835.

Ordered,

THAT a Select Committee be appointed to inquire into the best means of extending a knowledge of the Arts and of the Principles of Design among the People (especially the Manufacturing Population) of the Country; also to inquire into the constitution, management and effects of Institutions connected with the Arts:—And a Committee was appointed of—

Mr. Ewart.
Mr. Bernal.
Dr. Bowring.
Mr. Ridley Colborne.
Mr. Clay.
Lord Francis Egerton.
Mr. Elphinstone.
Mr. Grote.
Mr. Hawes.
Mr. Hume.
The Lord Advocate.
Mr. Lewis.
Mr. Oswald.
Sir Robert Peel.
Mr. O'Connell.
Mr. Shiel.
Lord Viscount Sandon.
Mr. Chancellor of the Exchequer.
Sir Matthew White Ridley.
Mr. Brotherton.
Mr. Potter.
Mr. George Evans.
Mr. Roebuck.
Lord John Russell.
Mr. Patrick Stewart.
Mr. Strutt.
Mr. Poulett Thomson.
Mr. Warburton.
Mr. Morrison.
Sir Robert Inglis.
Mr. Wyse.
Mr. Scholefield.
Mr. Edward Lytton Bulwer.
Mr. Henry Lytton Bulwer.
Earl of Kerry.
Lord Viscount Mahon.
Mr. Yorke.
Mr. Heathcote (of Tiverton.)
Mr. Baines.
Mr. Stewart Mackenzie.
Mr. Williams (of Coventry.)
Mr. Fort.
Mr. Davenport.

Ordered, That the Committee have power to send for Persons, Papers and Records.

Ordered, That Five be the Quorum of the Committee.

Mercurii, 22° die Julii, 1835.

Ordered, That Mr. Wilks, Mr. Hanbury Tracy, Mr. Buckingham and Mr. Hope be added to the Committee.

Veneris, 7° die Augusti, 1835.

Ordered, That Mr. Brocklehurst and Mr. Jephson be added to the Committee.

Veneris, 4° die Septembris, 1835.

Ordered, That the Committee have power to report the Minutes of the Evidence taken before them.

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REPORT.

THE SELECT COMMITTEE appointed to inquire into the best means of extending a knowledge of the ARTS, and of the PRINCIPLES of DESIGN among the People (especially the Manufacturing Population) of the Country; also to inquire into the Constitution, Management and Effects of Institutions connected with the Arts; and to whom the Petitions of Artists and Admirers of the Fine Arts, and of several Members of the Society of British Artists, were severally referred; and who were empowered to report the MINUTES of the EVIDENCE taken before them to The HOUSE:——HAVE examined the matters to them referred, and have agreed to the following REPORT.

THE COMMITTEE began its labours by dividing the subject of inquiry into the following parts:

THE state of Art in this country and in other countries, as manifested in their different manufactures.

THE best means of extending among the People, especially the Manufacturing Classes, a knowledge of and a taste for Art.

THE state of the higher branches of Art, and the best mode of advancing them.

The investigations of the Committee have been principally confined to the first and second sub-divisions of the subject.

The Committee lay the Evidence hitherto taken before The House, and recommend the resumption of the inquiry early in the next Session of Parliament.

September 1835.

LIST OF WITNESSES.

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Mr. *Robert Harrison* - - - 33

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MINUTES OF EVIDENCE.

Lunæ, 27° die Julii, 1835.

WILLIAM EWART, ESQUIRE, IN THE CHAIR.

Dr. *Gustave Friedrick Waagen*, called in; and Examined.

Dr. *G. F. Waagen.*

27 July 1835.

1. YOU are the Director of the Royal Gallery at Berlin?—I am.

2. What institutions have you in Prussia for the instruction of the manufacturing population in the Fine Arts?—We have a *Gewerb-Institut* at Berlin for the purpose of giving instruction in manufactures connected with the Arts.

3. Have you one, or more than one?—That is the principal one; we have smaller institutions, but these are merely schools of design, in Breslau, Koningsberg, Dantzic and Cologne.

4. How many are there altogether in Prussia?—There are five; there is the principal institution at Berlin, and the four smaller institutions.

5. Can you give the Committee any account of the schools of design in the other states of Germany generally?—If by this question is meant *Gewerbe-schools*, then I cannot.

6. Do such schools exist in other parts; for instance, in Saxony and Bavaria?—I believe *Gewerbe-schools* do not; there is a Royal Academy, where young men that learn manufactures at Dresden may attend.

7. Can you give the Committee any account of the management of those *Gewerbe-schools* in Prussia?—At Berlin, in the chief *Institut*, there is a collection of models representing the newest discoveries in Europe, and particularly in England; there is also a very complete collection of the finest ornaments and designs of the Greek and Roman and middle ages in plaster of Paris; also some of the most distinguished works of naked sculpture, especially the pure Grecian; the pupils there are also instructed in drawing, modelling, in mathematics and perspective; each one chooses his own department of manufacture; they are taught also the founding and casting of metal works and other manufacturing operations.

8. Is the instruction of those schools gratuitous?—Yes, the instruction is gratis.

9. Are those schools under the government?—They are entirely under the government, and the managers are paid by the government.

10. Is the whole expense of the institution defrayed by the government?—The whole is paid by the government.

11. Does that apply to the minor schools in the other towns, as well as the principal school at Berlin?—Yes.

12. Can you state the expense of those schools?—I cannot state it now, but I can easily procure an account, and I will do so. The whole of the establishment is under a director, whose name at present is *Beuth*, privy councillor of Finance, who has the management of the whole establishment.

13. Is chemistry among the subjects taught in the school?—Yes, there is instruction given in chemistry.

Dr. *G. F. Waagen.*

27 July 1835.

14. Is any branch of experimental philosophy taught?—Partially; there is some instruction given in natural history and physiology, and they have also electrical and other machines in the schools.

15. Are there any other arts and sciences taught in the schools?—I have mentioned all the most important branches.

16. How are the pupils elected into those institutions?—The pupils are recommended from the provinces by the *Government-president*, and sent to Berlin. They must have a knowledge of some manufacture; they must be able to read and calculate, in order to be received into the institution. If those young people do not show any aptitude after being some time, the institution is not compelled to continue the instruction to them; but they are sent back to the places whence they came.

17. Are they lodged and boarded in the institution?—No; they receive the instruction freely, but they must pay for their own board and lodging in Berlin.

18. Out of what classes are they selected by the government presidents?—There is no particular class of society out of which they are peculiarly chosen; when any individual is considered to show particular aptitude, no further inquiries are made, but that is considered a sufficient qualification.

19. Who makes the selection?—Any body may recommend any young man who has a taste for a particular branch of art to the president.

20. Do you know the mode adopted by the *Government-president* before he gives his certificate?—No, I do not.

21. What are the regulations as to the age of the pupils?—They cannot be received above, but may be received under the age of 16.

22. Are they then sent immediately to Berlin, or are they kept any time in the provincial schools?—They are sent to Berlin.

23. Is the same system pursued with respect to the minor schools at Breslau and Königsberg, and other places?—Those are preparatory schools, merely of design, where they do not undergo so strict an examination.

24. Are those who are sent to Berlin sometimes selected out of the provincial schools?—Sometimes they are, and sometimes not.

25. And sometimes they finish their education at the provincial school without going to Berlin?—When they do not want to take a very high path in art, they content themselves with more elementary instruction in the provincial schools. The Berlin institution is supplied with pupils not only from the minor schools, but selected by the government president from the mass of the population, as well as from the other schools.

26. How long do the students stay in the Berlin school after they have been admitted there?—I do not know whether it is two or three years.

27. How many students are there in the Berlin institution altogether?—The number is not positively fixed.

28. Can you state about how many there are?—I do not think the number in the principal school exceeds from 80 to 100.

29. Is the period which the pupil stays in the school determined by his age or by his attainments?—It is according to a certain course which he has gone through.

30. Can you state the number of scholars there are in the provincial schools altogether?—That is quite uncertain; the number of students in the inferior schools is much more uncertain and fluctuating than those in the principal school at Berlin, inasmuch as the quantity of instruction communicated is so much less.

31. Are those pupils prepared for all sorts of manufacture, for silk and cotton and metallurgy?—Yes, for every description of manufacture.

32. The school applies its instruction to every manufacture with which art is in any way concerned?—Yes.

33. During what portions of the year do they attend the schools?—The courses extend through nearly the whole year; they begin at Easter.

34. What are the hours of attendance?—The business of the institution occupies the whole day, and they are very laboriously engaged.

35. Are there any periodical examinations of the students?—I cannot say; when they are finishing a particular course, a special examination takes place upon that course.

36. Are there any prizes distributed as a reward for merit?—When there is any particular instance of remarkable industry and remarkable success, he gets a distinction

distinction and a prize, and he sometimes gets as a reward some work of art produced in the school itself.

37. In consequence of his attainments, is he recommended to any situation in any manufacturing establishment?—Yes; but it is quite natural, and it is the fact that where a pupil has distinguished himself in any particular manufacture in the *Gewerbe-school*, he goes to that part of the country where that class of manufacture is established, and meets with no difficulty in finding employment.

38. But he has no privilege in consequence of having gone through the school?—No.

39. Has he any title or diploma?—No.

40. Has he any certificate of having gone through the courses?—He has the ordinary certificate of attendance from the director of the institution.

41. Describing what branches he has studied?—Yes.

42. Do the certificates vary; for instance, supposing a man had particularly distinguished himself, does he get a different certificate from a man who had merely attended the lectures?—The certificates are more strongly expressed in that case.

43. Is there an annual examination before the king or the minister of instruction?—No.

44. How long have those schools been established?—I think about 20 years.

45. What has been the effect of those schools?—The spreading of those students through the provinces has improved the system of production, and the works they take with them have greatly tended to the improvement of the different manufactures of the country.

46. Has the cotton manufacture increased lately in Prussia to any great extent?—There has been a very great improvement in the cotton manufacture, particularly in the excellent patterns. The influence has not been confined to those who have come from the *Gewerbe-school* who have established manufactures, but other manufactures have been able to produce through that influence works of a higher and better character. The director *Beuth* has had a work printed at the expense of the government, with copper-plate engravings, which gives to the students most beautiful models of antiquity and the middle ages.

47. Are the patterns in the cotton printing the invention of the Germans, or are they principally copied from English or French?—The greater and better part of them are not patterns introduced from foreign countries, but are original designs made at Berlin.

48. Do the manufacturers ever send to the schools statements of what particular patterns they require to meet the public taste, so that the ingenuity of the school may be directed in the channel in which the demand is?—I could not say with certainty, but I know that a perpetual communication is kept up between the director of the institution and the principal manufacturers.

49. If a pupil intends to be a cotton manufacturer, does he turn to that branch of the art most connected with that manufacture?—Yes; the object of the institution is to unite beauty and taste with practicability and durability, and so to form the imagination and taste of the pupils as artists, by studying and drawing after beautiful models, that each may be enabled with facility to make discoveries in that branch which he particularly follows.

50. Is it the practice of the manufacturers to try the talents of the pupils in drawing patterns for any particular branch of art before they leave the institution; for instance, a calico-printer?—All the connexion which the institution has with the manufacturers out of doors is, that if a student should show a great aptitude for any particular branch, the director recommends him to the manufacturers in that particular branch.

51. Is instruction given in the composition of colours?—Yes; they study the mingling of colours.

52. Do the manufacturers apply to the school in order to get young men of talent for drawing patterns for any particular manufacture?—I do not know that, but I know that there is a great demand on the part of the manufacturers for pupils that excel in different departments.

53. Are any particular instructions given in the institution as to the preparation of colours?—Yes; that is one great point.

54. Are there any elementary courses which all the students attend?—Yes; they must all attend the drawing-school, and must all learn elementary mathematics.

55. Are you aware how long they continue in those elementary courses?—I think

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think that during the first year they are generally engaged in the common courses which are communicated to the whole body, and afterwards in the second and third years they pursue their own particular departments.

56. Is there any school of collection of patterns of manufactures?—There is; and it is the duty of the directors to collect from different countries the most remarkable specimens of patterns that are produced.

57. Are models of machines also collected?—Yes; they have a very large collection of models; for instance, they have models of different steam-engines, from their first production to the latest discoveries.

58. Do students come from Saxony to Berlin to attend the institution?—The principal object is to promote Prussian manufactures, and therefore only that portion of Saxony that is dependent upon Prussia enjoys the advantages of the institution.

59. Is there any similar institution in Saxony?—None of those institutions exist in Saxony; in the Saxon Academy the attention is more particularly directed to the higher branches of art, totally unconnected with manufactures.

60. Are there any libraries attached to those institutions?—Yes, there are, of general literature, and of all works relating to the objects of the institution.

61. Is there any botanical garden attached to it?—No; there is at the university one of the largest botanical gardens in the world.

62. And the botanical garden in the university would supply the institution with specimens?—Yes, certainly, if they are wanted.

63. Are there any anatomical courses in this institution?—Not in the *Gewerb-Institut*, but every pupil in the institution that wishes can go to the Royal Academy.

64. Do you know whether a portion of the instruction in the School of Arts is directed to the study of the human figure?—There is drawing after fine casts from the most famous antiques.

65. But they do not draw from the human figure itself?—No; but any one that wishes can go to the academy and draw after life.

66. Have the students in the *Gewerb-Institut* a right to attend the anatomical lectures without expense?—Yes, without expense.

67. Are the public lectures at Berlin open gratis?—In this institution, and in the Academy of Arts the lectures are open to every body gratis.

68. But not in the university?—No.

69. Therefore if a person wishes to study anatomy he must pay for it?—Yes; the anatomical lectures at the university, which are intended for the medical profession, are quite of another kind, and are not given gratis.

70. Is drawing from living models studied in the institution?—No.

71. Do they learn the proportions of the human figure in the institution?—Yes.

72. Have they any peculiar instruction in architecture?—Certainly they have, because they have models from the antique and the middle ages of all the most beautiful specimens of architecture; they have models of the Parthenon at Athens, and of the finest works of antiquity. There is besides an academy of architecture at Berlin, quite independent of the Academy of Arts, and of the *Gewerbe-school.*

73. Do they receive instruction with a view to the design of furniture?—Yes, every thing connected with household furniture in its widest extent, and the ornaments connected with it. They have models of the various forms of chairs, tables, tripods and every other domestic article. They have collected from every part small models in bronze, which represent all the most beautiful forms of antiquity for household furnitue and ornaments.

74. Have those schools any connexion with the academy of Berlin?—No; but if the student shows any particular predilection for the higher branches of arts, he studies anatomy or the living figure in the academy; this is the only connexion between the academy and the school.

75. Is design in any degree made any part of the system of education in Prussia?—It is; drawing is taught in the national schools in Prussia; in the lowest popular schools there is some small portion of instruction in drawing given, and a large proportion in the gymnasia.

76. Has that a tendency to produce taste among the people by exercising the eye?—Certainly it has a tendency to exercise the eye of the people.

77. Do you think that for the encouragement of the arts among the people, drawing

drawing should form a portion of national education?—Certainly, I think that for education drawing is very useful.

78. And you think it is of advantage for the propagation of the arts among the people?—I do.

79. Have you seen any considerable change in the character of the people produced by attention to those subjects?—We have not only seen great influence produced upon the people, but we have found among the people a great desire themselves to possess works of art.

80. What is the best mode, in your opinion, of applying arts to manufacture?—In former times the artists were more workmen, and the workmen were more artists, as in the time of Raphael, and it is very desirable to restore this happy connexion.

81. How would you restore it?—By giving the people an opportunity of seeing the most beautiful objects of art in the particular branch which they follow; by having collections of the most beautiful models of furniture and of different objects of manufacture. It is not enough however merely to form these collections; there must also be instructors to teach the people on what principles those models have been formed; furthermore, for the purpose of exercising the hand and the eye, it is useful that the young people should draw and model after those models.

82. What is the best mode, in your opinion, of extending taste and a knowledge of the fine arts among the people generally?—The best means of forming the taste of the people is by the establishment of accessible collections of the most remarkable monuments of antiquity and of the middle ages.

83. In what towns should such be founded?—In the capital of the country there should be the chief collection, but it is very injurious when all is centralized and confined within the capital; it is also useful, as is partly the case in France, and it is intended to be so in Prussia, to establish subordinate collections in the principal towns in the country. With respect to France, I myself have seen very admirable collections in Strasburgh, Rouen and Lyons.

84. According to what principles would you form those collections of art?—The principles upon which they should be established are the following: the monuments of the best periods, both of ancient and modern art which are too extensive and too costly to be possessed by private amateurs, should more especially be placed in a public collection, such, for example, as the Elgin marbles and the Egyptian remains in the British Museum; and such works of the best masters as both their size and their subject would prevent being received into private collections; therefore I think that a national gallery like that of England should be formed of pictures like the Sebastian del Piombo, the Parmegiano, the two Correggios bought from Lord Londonderry, and the Bacchus and Ariadne of Titian. It is most important that a national collection should start from this point, and be extended as much as possible in the direction of the other masters contemporary with Raphael, of whom there were many; for the works of such masters have a great influence in forming the taste in the best manner and in inculcating the best principles of the art; but in order to understand and still better appreciate the great masters, you must commence with those who immediately preceded them and who taught them.

85. Do you think that to produce other Raphaels they must go through the same process as Raphael himself went through?—Yes, and it is highly interesting to compare his paintings with the paintings of his master to see his progress. There should also be a few specimens of the earlier masters, and after giving a history of the early art and tracing it through the masters in the time of Raphael, I would follow it down through its declension during the last 300 years.

86. Will you state the manner in which you would arrange the works of art?—To arrange a public collection, it should be so formed as to combine taste with instruction; both are attained by an historical arrangement; such an arrangement, by following the spirit of the times and the genius of the artists, would produce an harmonious influence upon the mind of the spectator. The spectator would also, when he goes to the gallery, see the historical development of the art. For example, I consider the arrangement in the British Museum of the Elgin Marbles, and the Egyptian remains and other collections in separate rooms, as a good arrangement, which creates an uniformity of feeling with regard to the times at which they were produced. In respect to the superintendence of the gallery, I wish to make a distinction between that which is mere art, and that which is the literature of the art; there should be one professor to explain the historical

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literature of the art, and another to teach the practical application of the art; those collections can only propagate taste and art in a nation when every man can daily and hourly find free access to the collections of art; in Berlin the Museum is open on all days throughout the year except Sundays, from ten till four in the summer, and from ten till three in the winter; the holidays are about 10 or 12 in the year.

87. How many days are required for cleaning the Museum in the course of a year?—Every day after the people have left, the whole Museum is cleaned.

88. It is never closed for the purpose of being cleaned?—No.

89. Is it necessary, in order to enable the students to copy, to exclude the public?—At Berlin we never exclude the public for the purpose of accommodating the artists. We pursue the same course which is pursued in the famous gallery at Dresden, where the public are constantly present when the artists are at work, and the artists are completely accustomed to it.

90. In your opinion it is not necessary to exclude the public for the purpose of instructing the artists?—No.

91. What number of visitors have you at the Berlin gallery in the course of the year?—We have about 50,000; it is my opinion that the art is more advanced by the public generally seeing paintings than by the artists copying particular pictures. We find that in Dresden, where there is more copying than any other gallery, with good models before them, the art has very much declined, and we find that the artists themselves are not so much improved by copying as by attentively contemplating and studying the best masters. I feel a great objection to making art so completely imitative as that artists should be employed in copying pictures, and I think that art would be more advanced if they were made objects of general observation.

92. Do you think it is desirable that those galleries should be open on Sundays?—I should consider it advantageous if those collections were open on Sunday for a few hours; and I take the more interest upon this subject, because I am convinced that the days when the Museum is closed, namely, the Sundays and holidays, are the only periods when it is accessible to the working people. In addition to this, it is very important to have short catalogues with introductory remarks, giving a short history of the art, with remarks upon the objects exhibited, so that the spectator, when he enters, may not be quite ignorant of the subject; besides the large *Catalogue Raisonné*, I have a short catalogue with a few introductory pages, to instruct the visitors in the history of the objects they are going to see, and a critical account of the principal masters.

93. Would it not be a good plan to divide the National Gallery into compartments, according to the schools of the painters, and to put up the names and the dates of the painters?—Independently of the catalogues, I hang upon certain portions of the wall a little paper, containing the pictures in each division, with the name of the artist and subject of each picture, and the date, arranged under the head of the school. To apply those collections to proper purposes, it is desirable that there should be lectures upon the earlier down to more recent times of art.

94. Would you have them delivered in the gallery in the presence of the pictures?—No, that is not possible; but the teacher can refer to the pictures by the number. I think the National Gallery should have the power, when it received bequests of persons, to exchange or transfer them to the provincial galleries, and the power of selling, for the benefit of the gallery, any which might tend to degrade the taste.

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95. In what way, in your opinion, do you consider that the exercise of the fine arts in a country can be practically promoted?—By practical institutions for instruction for that special object.

When we consider the various methods by which the arts have been taught at different periods, we observe, from the 13th century downwards, at which time the fine arts awoke into new life, to the middle of the 16th century, and in many countries to the middle even of the 17th, the arts were taught after the manner of artizans, then very young, from the age of 10 to 12 years. The artist entered into the workshop of the master artist, and made himself, while quite young, master of the technical part of the art; and as he was permitted to behold works while under the hand of the master and his best scholars, he had a vivid conception of the art, and he had an opportunity, by seeing the practice, of turning it to the best account in the different branches, as, for example, drawing, painting, modelling and

and so forth. The master had an interest in the earlier attainment of knowledge in his scholar, as he expected assistance from him in his productions, and it was important to him to be able soon to entrust to him works of greater importance. When the scholar felt himself so much advanced that he could execute works of his own composition, he then quitted the workshop of his master in order to work on his own account. According to this simple mode of instruction, art is indebted for its greatest works. From such work-shops as these came forth masters, such as Leonardo da Vinci, Michael Angelo, Raffaelle, Titian and Corregio. The great masters in the Netherlands school, Rubens, Rembrandt, Cuyp, Ruysdael, Hobbima, and so many others whose works every man of taste admires, were formed in the same way.

Although already in the 16th century, there were several unions of artists, which bore the name of academies, the institutions of this kind in which art was taught as in modern academies, are not older than the middle of the 17th century; that at Paris was established by Louis XIV. in 1648. Most of the academies first rose in the course of the 18th century; they owed their origin to the endeavours of princes and artists to raise and renovate the sinking art. They thought that their object might be thus the more easily obtained, inasmuch as they abstracted certain rules from the works of former artists, and according to these rules instruction was imparted. That this instruction might be thoroughly imparted, they divided the instruction, so that drawing after the antique, drawing after the living model, anatomy, painting, perspective, and the laws of taste and composition, were each taught by different professors. In this manner it was believed that they could not fail to bring up most perfect artists.

The result did not answer the expectation, however thorough the instruction was in each of these divisions of the art. All these rules could not replace the intimate and personal relation between the old masters and their scholars, for in academies generally every professor believes he has done enough, according to the rules of art, when he has imparted his instructions, and does not feel himself induced to trouble himself about the progress of his pupil. We have even known instances in which the professor did not wish the pupil to be present at the time he himself was working. It is also injurious when the academies employ different professors to lecture the same pupils on the same subject, as, for instance, in drawing after the living model; for I have experienced that one professor has been of opinion that the pupil should copy the living model, even with all its faults, while another professor in so drawing would idealize and improve upon the form, or transpose the model into an universal scheme of his own; and each professor corrected the drawing of his pupil according to his own rules, by which means the pupil knew not which way to turn.

Instead of following the "mode of feeling" of a distinguished master, to which the pupil attached himself as to something living, until he was confirmed in the development of his own sentiment of art, in academies the cold general rule is substituted, which the young man is strictly bound to follow, according to the infallible direction of the professors, as the only correct method. In this manner, in the eighteenth century, a great number of works of very limited merit were produced, in which all academical rules of composition, drawing and *chiar' oscuro* were strictly observed, which, notwithstanding, appear only as well executed exercises, and leave the spectator cold, because they are wanting in the first and most indispensable attributes of works of art, namely the impress of the vivid individual feeling of the artist, which is the real soul of a work of art. If it possesses this "impress" of the artist's feeling, we overlook the possible defects in drawing and colour, as so many works of the ancient artists prove; when this "impress" is wanting, the most perfect acquirements in other degrees of art cannot replace it. The natural result of the academic institutions consequently was, that on comparing a number of specimens of the different schools, such as those in Paris, Petersburgh and other places, all exhibited a striking similarity of manner, while in the earlier times and the earlier method of teaching, the character of the schools of different nations and that of each individual artist, was entirely original and distinct; as in the Dutch gardens, the different kind of trees were clipped to the same forms, so it was the case in academies with the different talents of different pupils. Would not any one feel a greater pleasure in the free growth of the trees in a forest, in preference to the monotonous uniformity of a Dutch garden? By this academic method, which deadened the natural talent, it is sufficiently explained why out of so great a number of academic pupils, so few

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few distinguished painters have arisen. The three most distinguished artists which, for instance, Germany produced in the eighteenth century, namely, Mengs, Denner and Dietricy, owed their education not to academies, but were educated after the old manner. So, in our own days, the two most distinguished of the living artists of the German school, Cornelius and Overbeck, have risen to eminence in the most decided opposition to the academies; and the most eminent modern English artists, namely, Sir Joshua Reynolds, Barry, Wilson and Flaxman, did not receive their artistical education in an academy. That these men, when they were already celebrated artists, became members of academies, has nothing to do with the question, which is simply this, whether the academies have attained their objects as institutions of instruction. It must not, therefore, mislead us in favour of academies, that in our times a great many of the most celebrated artists have been members of academies; from the beginning, it must have been the interest of these academies by the reception of persons who enjoy a great reputation, to procure to the academies splendour and distinction, which otherwise would often have been wanting. With this, another injurious effect of the academies has been connected, by means of the official distinctions which the academies enjoy through the influence of the State. They have attained a preference over all the artists that do not belong to the academies, which the academies watch over very jealously, and have thus introduced into the freedom of art an unsalutary degree of authority and interference. It occurs often that a very *mediocre* artist, of which every academy counts some few among its many members, stands much higher in the State as an academician than the most talented artist who does not belong to an academy. As the majority of mankind look more on authority than on genuine merit, it has occurred often that a moderate artist being an academician has found plenty of employment, while artists of considerable talent who do not belong to such an institution, remain unemployed and unnoticed. If it is asked how the artists in modern times can be taught in a better manner, we may lay down the following remarks. The favourable relation in which the pupil stood to his master in the ancient times, might be restored in a certain degree by these means, that artists of distinguished reputation should be induced to open *studios*. Most artists would be induced to open studios if the Government provided them with the locality, and a moderate remuneration; besides this, every pupil would have to pay a moderate sum for the use of living models. How important such a system is for the formation of artists, may be seen in the example of Prussia; for sculpture, the studio of Professor Rauch, in which many distinguished artists have formed themselves in a good manner; and the most remarkable instance in painting is the school of Dusseldorf, which the Government founded under the direction of William Schadow eight years ago. Within this time several artists have distinguished themselves, who in originality and ability have surpassed all who for a long time have been formed in the academy at Berlin.

Together with these schools the academies can also continue to assist, in so far as thorough and uninterrupted instruction is given in anatomy, perspective and the history of art, for which instructions they are responsible to the State, and for which the State should give them some remuneration. Those branches of the art which are too expensive for the studio of the individual masters, might be pursued at the academy with the greatest advantage, by the students, under the direction of their own immediate masters.

The above method may be pursued with advantage by painters and sculptors, but the case is quite different with architects; architecture is divided into ornamental architecture, building in the water, military architecture, &c.; it is also connected with so many handicraft trades, as bricklayers, carpenters, and so on; it is in all these respects of such necessity and importance, that it is necessary to have a public institution in which all these subjects are thoroughly taught. The taste as well as the technical execution of buildings, might, by such institutions, combined with a collection of models, remarkably promote this branch of art. The connexion of a student in architecture with a certain master is of less importance than in the case of painting and sculpture. In this manner an institution of the kind exists in Berlin under the title of a *Bau-Academie*, or an architectural academy.

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96. Will Professor Waagen continue to express his opinion, which he obliged the Commitee, with, on the subject of public exhibitions, and the means

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means of extending the knowledge of the arts among the people?—The second mode of distributing knowledge among the people would be by means of public exhibitions. It is in no case right that any man should be judge in his own case, and it is not advisable that a number of artists, who are about to exhibit their own works, should have the sole right to decide what works are to be admitted, and how other and different works of art are to be placed in the exhibition. In order to avoid all partiality, it would be effectual if the State was to appoint a Committee which should be composed of artists and connoisseurs of taste and judgment; and to make exhibition more generally accessible, it would be advisable to lower the entrance money from 1*s.* to 6*d.* It would not be advisable to make the exhibition gratuitous, as most persons bestow more attention on what they have paid for, than on what they see gratuitously. Out of the income derived from the exhibition, the members of the Committee are to be remunerated for their time and trouble, and premiums are to be awarded to the artists who contribute their works, according to their estimated value, upon which the Committee will have to decide; and as far as the artists who are members of the Committee have pictures in the exhibition, the other members not being artists shall fix their value, in doing which they will consult other distinguished artists not members of the Committee. These exhibitions are to be appointed by the State, not merely in London, but also for other towns of importance.

97. What other means do you think advisable as a powerful means of encouraging the exercise of the fine arts in this country?—Thirdly, by the purchase of the more distinguished works of art, works of art of distinguished merit, which the public have decided shall be purchased by the State, after the example of the Luxembourg Gallery at Paris, and collected in an especial locality as a national museum of British art. Similar collections of national art should be made in the other principal towns. It is one of the objects of the German Institution of art, called *Kunst Verein*, to assist less wealthy individuals in attaining possession of paintings and sculpture. In order therefore to admit the greater number of members, the annual subscription should be moderate, which even in London might be 2*l.* Out of the amount received by this means paintings and sculpture are bought by a Committee elected by the members from among their number by ballot, and then distributed to the members by a lottery. Of what advantage would be such a *Verein* may be shown by the example of those which were established in Berlin by a number of individuals about 10 years ago, under the patronage of the King, and the presidency of the Minister, Humboldt, which has had such success, that with an annual subscription of 15*s.* the annual income is now 1,200*l.*, by which means several meritorious artists find employment, and good works of art are spread over the country; and this *Verein* has given so much satisfaction that since then eight others on a smaller scale have been established in the provinces of Prussia. Further, in Bavaria, Saxony, Wurtemberg and Hanover, similar institutions have since arisen, by which the feeling for and an interest in the arts has been extended in an extraordinary degree in Germany.

98. What other means do you recommend for extending the produce of the fine arts?—Fourthly, by the employment of artists in public buildings, and although sculptors have been so repeatedly employed in the execution of public monuments, yet hitherto it has not been the case with painters; and thence we may trace the principal reason why England is so deficient in historical works of painting. The construction of the new Houses of Parliament would afford an honourable opportunity for it, and national art would produce a more respectable ornament in their walls than the most splendid and costly hangings. For several reasons fresco painting might herein be employed to advantage.

Mr. *John Jobson Smith*, called in; and Examined.

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99. YOU come from Sheffield?—I do.

100. What branch of manufacture do you particularly pursue?—Iron foundry, applied to ornaments.

101. What is the name of your firm?—Stewart, Smith & Company.

102. Have you occasion to have models made to a great extent?—We expend about 1,500*l.* a year in the production of models of this kind for stoves and fenders alone.—[*The Witness produced a model of a stove front.*]

103. Are your models, some of them, very beautiful?—They are very beautiful.

104. Has Sir Francis Chantrey expressed any opinion upon them?—Sir Francis

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Chantrey has seen some of them, which he said were the finest specimens of iron manufacture which he had seen in the kingdom.

105. In those works of art, how far is the inventor protected?—There is no protection at all; we have sent out such a thing as that on Monday morning, and it has been to Manchester, back again to Sheffield, and copied and returned to Manchester before Saturday night. The model which I am now speaking of cost us 50*l.* for men's labour.

106. Is the copy as good as your original work?—It is not; but they sell them so much cheaper, because they pay nothing for the production.

107. This of course is great injustice, and serious loss to the persons that invent the designs?—It is so great a loss, that we shall give up continuing it; I suppose that more than one-half of the patterns for stove-grates and fenders used in England have originated with us, but the piracy has come to such an extent, that unless there is some protection we must give it up altogether.

108. What would you suggest as a protection?—I should suggest some place, such as the National Gallery or Somerset House, where those things should be registered and some mark put upon it, such as the royal cipher or crown, denoting the registry, and a protection given for a certain time, three years perhaps.

109. Are you aware of the system by which patterns are protected in France?—I am not aware.

110. In the manufacturing towns of France there is a body consisting of one-half workmen and one-half masters, and to them the preservation of the patterns is confided by the law; the pattern is examined by this body, whose knowledge of the manufacture is sufficient to ascertain that it is original; the right of the presenter of it is recorded, with a given date, a small sum is paid for a protection for a certain number of years, and that record and the preservation of the pattern which is deposited in the hands of this body, enables him at once to enter legal proceedings against any pirater of the patent; do you think any such system of protection could be brought to bear in England, or can you suggest any better system of protection than that?—I should almost fancy that it would be impracticable in this country, because there is not such a location of the casting of iron.

111. Do you think a central board would answer the purpose?—I should think the object might be effected by a central board, where an actual cast of the original model might be deposited and registered, and left there a certain time for examination as to its originality, and the fact of its being registered might be proof of its originality after a certain time.

112. Would not the great difficulty be, that the persons who purloined patterns are ordinarily very inferior men, who could hardly repay the damage they have done?—It is not the case in articles of this kind, because there must be a considerable capital invested in the manufacture to produce it.

113. You think if you could verify the fact of your being the inventor, there would not be much difficulty in inflicting the penalty?—I think not.

114. You think it would not be worth the while of the inventor to go to the trouble and expense of registering unless the invention was worth protection?—No.

115. What are the class of artists that you employ for the production of patterns?—Some artists in London have been employed to make patterns for this description of goods. The young man that made this which I have produced has had no education in the art; he has studied from nature altogether, and this is a specimen of his production; he has risen so as to have the reputation of being the first in the trade.

116. Is he a person of considerable natural talent?—So much so that we have given him a share in the business on account of his natural talent.

117. Are those models drawn upon paper?—Yes; and if we were to confine ourselves to publishing them on paper, the law would give us a title to protection for them, but as soon as we bring them out in the form of a manufactured article we lose all right and title.

118. Are there several artists in Sheffield capable of producing such models as these?—There are several.

119. Have they increased of late years?—No.

120. Do they get tolerable wages?—They do not get very good wages, because the manufacturers in the neighbourhood so depend upon piracy, that they do

do not employ them; but if protection were afforded them, each manufacturer would be forced to employ an artist.

121. You think that if art were better protected in this country, there would be a greater demand for beautiful designs?—There would, because the general taste is so much better than it was, that very superior things are now in demand.

122. To what do you attribute the improvement in the public taste?—I have sometimes attributed it to the fact of there being so many fine models in plaster for the external and internal decorations of rooms, by which means they have become better spread.

123. Do not you think that the opening of our intercourse with the continent has led to a great improvement in the national taste?—It has. French ornaments and French style have become introduced into this country, and become ingrafted into our own style.

124. Have you been able, notwithstanding the heavy duties upon this species of article, to export any to France?—No; we can send none to France; there have been some smuggled to France.

125. Do you think that the foreign models are superior or inferior to the English?—In this branch of manufacture I think they are inferior.

126. Are you aware that grates are not used in France?—They are used in France, I believe; they are porcelain grates very generally.

127. Are there persons employed at Sheffield to form those designs on paper?—No.

128. Have you attended to fenders as well as grates?—Yes.

129. Are the artists employed at Sheffield generally uneducated, or do they undergo some previous education in art?—They have had no education at all; it is a few men of natural talent, who have been accidentally directed to drawing very early, who have followed it up in this way.

130. Do you know any place in this country where a young man could obtain such knowledge?—No.

131. Have you a Mechanics' Institution at Sheffield?—We have.

132. Do not they instruct the young men gratuitously in design?—They have got several works of design, but there is no instruction given; those works however have been of great service.

133. Do you think it would be a good thing to extend the means of instruction in design among the people?—Certainly.

134. And especially to open collections of the best specimens?—Yes.

135. Have you often heard among artists a wish expressed that the knowledge of art should become more accessible to them?—Yes.

136. Do you know any class of persons in this country who are capable of teaching that kind of art to which you allude?—I am not aware that there are any except at very great expense.

137. Have the parties who draw those patterns been instructed at all in drawing?—Not at all.

138. And the state of the law is such that there is little encouragement to artists?—A capitalist will not purchase the higher order of talent, because no sooner does he produce it than it is stolen from him.

139. What can an artist obtain per week by devoting his time to the production of models in Sheffield?—About 3*l.* or 4*l.* if he is a clever man.

140. It is then the best paid labour?—It is.

141. How many artists do you suppose in Sheffield are solely employed in producing models?—Not above four.

142. Have they been all successful?—One of them has not been very successful.

143. Do not you think the public taste is so much improved that encouragement would be found for the production of articles more and more beautiful?—We find that we cannot produce articles too expensive for the public taste of the present day. Could we employ artists of a higher character, I am satisfied that the public would buy whatever was produced.

144. You think that cost would be no barrier to the sale of beautiful articles of art?—No; I should not myself hesitate in expending 200*l.* or 300*l.* in the production of a model for a grate to-morrow, if I had protection for it; but now it is certain that every thing worth pirating is pirated in three months; many things that are very good are pirated in 14 days after the time of their production.

145. As the taste is perpetually varying, how long would you conceive a sufficient protection to a pattern?—I think three years would be the least. The

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custom of the manufacturers of those things is to visit their correspondents once in six months, and it frequently happens that there is some reason for not having a new thing at the time, and it is frequently a twelvemonth before a pattern comes fairly before the public. I think we should have a fair protection for three years.

146. Unless you give rather a long period to the protection of a design, is not the effect of it to allow only a man of large capital to reap the advantage from the protection, because he only can put out a sufficient quantity of the pattern to remunerate himself?—Yes; every person to produce things of this kind must keep an extensive establishment about him. Besides the payment of the designer and the modeller, there must be workmen who get high wages after they have been designed and modelled.

147. Would the amount of capital employed in your business depend upon whether you had a protection for two years or three years?—No.

148. Does what you state apply, not only to your own line, but to all other lines in Sheffield?—Yes.

149. And more especially to steel and plated goods?—All the articles of plated goods that are stamped.

150. Have you conversed with persons whom you think most capable of judging of the propriety of legislative measures to protect such inventions?—I have.

151. Is the plan you have suggested of a Central Board the result of your inquiries among them?—It was my own opinion. I have not spoken to others respecting the details of the protection, but only generally; and I have the authority of Sir Francis Chantrey to say, that he decidedly coincides in my views, and he thinks that it is most desirable that something should be done for the protection of arts of design.

152. Do you consider that the suggestion you have made would be practicable without interfering with the general convenience of manufacturers throughout the kingdom?—There is a certain class of manufacturers whose convenience it would most materially interfere with, in the same way that the police interfere with the practices of certain men.

153. You say that you think you ought to have it for three years; by what means could the numerous manufacturers of similar articles throughout the kingdom know when the period had expired?—I would say, that upon each article registered there should be a royal cipher and a crown cast, and a penalty should be attached to the casting that without a register, and there should be a penalty attached to casting it after the period of protection had expired, so that the public would know what articles were under the protection.

154. Suppose you put a crown upon an article on the 27th of July, how could a man that makes similar articles in Scotland, upon seeing one of those grates, discover from it whether your protection commenced in 1835 or 1837?—There would be the central register here, which should be open to the public, and he might obtain a drawing of any particular design by applying to the Register-office, and if it was worth his while to make it, it would certainly be worth his while to apply for a drawing of it; but if it was necessary, the date might be put upon most things; upon a large article it might be done with the greatest facility, but there are many things so small, that we could hardly put the date upon it; for instance, an ornament that would have to be cast in the sand.

155. Do not you think, that if there was not the facility of copying that now exists, any new invention would be more slowly promulgated through the people?—We visit every town in England twice a year, and therefore the whole country has an opportunity of having those things if they please. The fact is, that instead of each house making designs for itself, or each employing an artist competing with the artist of another house, there are not above two or three now producing models for the whole of the kingdom.

156. Do you think it would be possible to effect the object in this way, by allowing the inventor to permit other persons to use the invention upon payment of a certain sum to himself?—I do not think that could be done; I think men would be more disposed to produce their own, than to live upon the reputation of their neighbours.

157. Is not there great difficulty in discovering what is a distinct pattern, and what is only a variation from a previous pattern?—There is the greatest difficulty there; but I think persons would not be willing to produce a pattern that was doubtful as to its originality.

158. Do

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158. Do not a great number of ornaments consist of a combination of old materials, and is it not likely that any other individual might combine those materials in a manner so similar as to make it difficult to know whether he had the object of piracy in view, or whether the similarity was not casual?—There would be so much of the particular mind and style of the artist, as to fairly constitute an original.

159. Is not this particular grate now before the Committee a combination of common ornament?—There has never been any thing approaching this before.

160. Unless it were so distinct, would it be worth your while to pay so much to your designer for it?—Certainly not.

Jovis, 30° die Julii, 1835.

WILLIAM EWART, ESQUIRE, IN THE CHAIR.

James Morrison, Esq. a Member of the Committee, was Examined as follows.

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161. YOU are at the head of a large commercial house in the city, are you not?—I am.

162. Of the well-known firm of Morrison & Company?—James Morrison & Company is the name of the firm.

163. You are large purchasers of manufactured goods in this country, as well as on the continent, are you not?—We are large purchasers of manufactured goods in this country, and also purchasers to a considerable extent of goods on the continent for home trade, as well as for export trade.

164. You of course have been well acquainted for many years with the relative state of the manufactures of this country and other countries?—I have been well acquainted with the state of the manufactures of this country for more than 20 years.

165. Has your acquaintance with this subject induced you to make any observations on the inferiority or the superiority between British and Foreign manufactures, as far as the arts of design are concerned?—As a matter of business, I have been long acquainted with the general state of manufactures, and as a matter of curiosity I have paid attention to the arts of design as applied to manufactures in foreign countries.

166. Do you consider the English manufactures superior as far as regards the manufacture of the goods, but inferior in that portion of them which is connected with the arts?—I have found generally that we have been very much superior to foreign countries in respect of the general manufacture, but greatly inferior in the art of design.

167. What are the principal articles in which you consider our inferiority in art is perceptible?—It is very strikingly the case in all the arts of design connected with the silk manufacture, which is essentially a fancy trade.

168. To what circumstances do you attribute the superiority of foreign manufactures in art over our own?—To the fact that on the continent they have public schools for teaching the art of design; that it has been part of their system to educate men as professors of the art of design as applied to the manufactures, and also as teachers; whereas in this country we have neither the one nor the other.

169. Have you not had an opportunity of visiting establishments abroad for connecting design with manufactures?—Having travelled on the continent on different occasions, I have always visited the manufacturing establishments with a view to judge of their state as compared with that of England.

170. What institutions have we at home corresponding with those abroad, which you think will in any degree enable the manufacturing population to acquire a knowledge of art?—For the improvement of the arts in connexion with manufactures we have no establishment whatever. At the Royal Academy the attention of the students is directed chiefly to the human figure. We have I believe private teachers in London, but I hear that they also apply themselves more

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particularly to the human figure, and in fact they educate people for painters and sculptors, rather than as artists for manufactures.

171. There does not exist in this country that cheap mode of acquiring a knowledge of art, which abroad is demanded by the manufactures?—We have no kind of public school of art as applied to those objects. I believe I can state that with regard to several of our large towns, though there are persons that are called designers, yet they have not been educated as such, and in point of fact, they know little of the principles of art.

172. Do you think it would be of great importance to our manufactures to encourage a familiarity with design among the manufacturing population?—There is no doubt that it would be desirable that it should be encouraged, and I should say in this country more especially it seems an absolute necessity, because some branches of our manufacture really languish from the want of encouragement in the art of design. I should further say, that with respect to the art of design, there is no want of encouragement on the part of the public, and that we are now, and have been for a long time, obliged to resort to the continent for the purpose of purchasing their new designs, and in fact our manufactures have been greatly benefited by the opportunity of purchasing foreign art in that shape.

173. You mean to say that even the competition, with the opportunity of seeing their patterns, have been a benefit to our own manufactures?—The truth is, we have generally copied the French patterns, and if we have attempted to alter, we have only injured them, so that, in point of fact, they are all French; I am now speaking more especially of the silk trade.

174. Have you ever been struck with the great attention and activity the subject of patterns excites in France, and that it increases the value of the article?—I consider it is a matter on which the manufacturer there chiefly relies, and if he is fortunate in his patterns he makes a successful year; if otherwise, his profits are materially less.

175. Is it not generally the opinion of the French, that the man who is lucky in a pattern, is the fortunate manufacturer of the year?—Certainly. I have understood in certain houses that the manufacturers were doing well, because they had been fortunate in their patterns; their success for the season resulting from their superiority in that respect.

176. That shows the importance they attach to it, does it not?—Yes.

177. Is it perceptible in such articles as silks, ribands, shawls, gloves, and also fancy goods of every description, that they have this superiority?—It applies more particularly to the silk trade, but it applies also to woollens, and generally to all articles in which there is a figure.

178. Does it not also apply to metals?—The art of design more particula ly applies to the metals, in which I think we are greatly deficient.

179. Does it not apply also to the arts as applied to architectural decorations, and the designs with respect to houses?—Particularly so; I understand from architects that there is a great want of that kind of talent in connexion with architecture; so that however good a design may be, the parties executing it not having been taught the principles of art, are not able to execute fine designs as they should be.

180-1. In the architectural changes that have been going on, have you been struck with the want of that superior taste which you think we ought to have?—Yes, the deficiency is certainly evident.

182. In fact, there is a connexion of course between the arts; the higher branches of the arts, and mere household furniture?—Architects have, I believe, attended to that subject of late years more than they formerly did, from the labours of Mr. Bullock some years ago, and I would add especially the publication of Mr. Hope's book. Much improvement has taken place; but no doubt great advantage would further arise from the establishment of a school of art, embracing form, proportion and ornament, and this advantage would not be confined to the manufacturer of furniture, but it would be extended to the country at large, because it would give employment to many, as well as be an improvement to the public taste.

183. Is not that perceptible, the connexion between the classical, the antique and

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and the common purposes of decorating the interior of houses in many instances in which the patterns from Pompeii have been adopted with great success in public as well as private mansions?—Without entering on questions connected with the higher orders of art, I should say all those matters influence our taste, but I have some doubt whether they would be suitable to our habits.

184. Have you observed in Paris, that much of the designs of Pompeii have found their way into the shops and private houses?—I cannot say that I particularly observed them there.

185. But in those buildings lately in London, do not you trace in the alterations of the Pantheon and in the decorations of the Lyceum Theatre, the very same designs that you trace in Pompeii?—No doubt of it.

186. Does not the Arabesque style, which was a style peculiar to Pompeii, prevail very much at Paris?—I have observed it in France, and also in Italy, and I am told that the Arabesque, about 35 years ago prevailed in this country.

187-8. Are you aware that in Italy the class of decorators form a very numerous class indeed, particularly in Southern Italy?—I should suppose from their works it must be so.

189. And are you aware that there are scarcely any houses, except the very lowest houses, of the inhabitants which are not in some way or other decorated by one or other of these decorators?—One sees the evidence of a feeling in favour of art every where in Italy, and one rarely observes it here.

190-1. Did you, upon the whole, observe, during your excursion on the continent, where there was existing a great mass of population, and where there were fine specimens of the arts, either in architecture or sculpture or painting, that a taste in favour of the arts appeared to be general and diffused, and to be operating upon the mass of the population?—There is no doubt that, admitting the public at large, especially the working classes, to see fine collections of works of art, has been eminently useful, and that it gives them a taste for the high character of art.

192-3. You think it very desirable to encourage the arts as connected with the architectural decorations of the interior and the exterior of our houses?—I alluded to that in connexion with the manufacturing arts; and I think it is very important that they should be encouraged.

194. Do you think that the French are more skilful than we are in the combination of colours and in chemistry as connected with manufactures?—I think they are. We have to lament that we have not a better educated class in chemistry as well as in the art of design. I believe the French are superior to us in both these.

195. Have you ever turned your attention to the best means of encouraging this knowledge of art among our manufacturers; would you think it advisable to establish central schools in London, or provincial schools?—I think a public school in London is, in the first place, absolutely necessary. After persons shall have been prepared to teach, there ought to be similar institutions in the large manufacturing towns.

196. Do you think that in London they would have greater facilities for acquiring information on all those branches of art connected with the manufactures; London being the emporium of art, as it were, there would be greater opportunities for artists of every description to learn that which was applicable to that branch of the manufactures which they intended to pursue?—No doubt of it.

197. Are you aware that at Berlin they have schools of that kind; that the principal school of art as connected with manufactures is in Berlin, and that there are provincial institutions existing also separately from those in Berlin?—I have understood such to be the case, but I have never been at Berlin.

198. Have you not been so much impressed with the propriety of encouraging such institutions, that you yourself have taken an active part in trying to encourage the establishment of them?—I have felt so much the want of such institutions, especially since the discussions on the subject of free trade and the admission of foreign manufactures, knowing our inferiority was altogether in the art of design, that seeing the thing was not done, I have myself offered to assist in the establishment in London of a school of art connected with manufacture.

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199. In fact you were so convinced of the beneficial effect it would have, that you offered to make a very considerable advance yourself to assist that object, did you not?—I did.

200. And several other gentlemen, and many eminent persons, and among others Lord Brougham, took an interest in the question, did they not?—Lord Brougham has always taken great interest in it, and something I imagine would have been done, but for the expectation that Parliament would have adopted some measure.

201. You have, of course, turned your attention to the means of encouraging manufactures, by opening to the eyes of the people, galleries, collections of casts, in fact, giving them every opportunity of instructing their minds in art, and creating a desire for art, by the observation of that which is beautiful?—Undoubtedly, it is most desirable that they should be encouraged to visit such institutions; and I very much regret that the British Museum and the National Gallery are closed on those days upon which it is the most convenient for the labouring classes sometimes to attend.

202. Do you think that sufficient attention has been paid to what may be called the education of the eyes of the people by our own Government, or has it been as much attended to as that species of education has been attended to abroad; that is, by freely opening galleries to encourage and increase the taste of the people?—I think it is a very extraordinary circumstance that, whilst in small states, where there are scarcely any manufactures, one hears of schools of design, yet in this country, at the head of the manufactures of the world, and where it would be of the most importance, we have nothing of the kind.

203. Have you ever considered how far the Government should interpose in the encouragement both of institutions like open galleries and instruction connected with the education of artists?—It is rather difficult to say how far the Government should interfere. If the public could be induced to interfere, they would do it generally better without the Government than with it. But I think Government in this case, as in the case of the National and British and Foreign Schools, might grant a certain sum of money in aid of local subscriptions.

204. You think they might superintend and interpose without unduly interfering?—I think they might assist in the establishment of such an institution, and, when established, it might afterwards support itself.

205. You think it is of sufficient importance to be made a national object, do you?—I think it is at its commencement. I think also, that the extension and improvement of our national works of art, would be a very wise use of the public money.

206. Are you aware that in France the Government assists the municipalities in the formation of such institutions?—I have so understood.

207. Are the Committee to infer from what you have said, that there is no want of talent in the country, but that there is a want of encouragement for the application of art to the purposes of the manufactures?—There is clearly no want of talent, because in those branches of art which are encouraged, I think we are decidedly superior to other nations.

208. Have you had an opportunity of considering the want of protection for inventions of patterns and designs, both in tissue goods and also in metal works, in this country?—I think the want of protection is, in all cases, an immense check to the progress of the arts of design.

209. The question has reference to the want of protection in the patent right?—There can be no want of encouragement on the part of the public, because all the manufacturers allow that if they produce very superior articles, however expensive they may be, there are parties ready to purchase them. The reason why they do not produce more and better, and why they do not encourage artists to follow that as a profession, is that their patterns, if good, are immediately pirated.

210. Do you think it desirable that the law should give a better protection to the original inventor of these designs than it does at present?—I think a protection for a limited period, sufficiently long to encourage the manufacturer to make the outlay of his money in the first instance, avoiding, as far as it is possible, the confusion which would arise from a great number of persons claiming the

right in similar patterns, as they must resemble each other. I think that is the sort of protection that should be given. It should in many cases, I think, be limited to a season, say six months ; in other cases perhaps a period of one, or two, or three years might be necessary.

211. Do you not think that there has been a great improvement in the productions of this country, though you think that there has been no improvement in art as applied to manufactures?—There has been a very decided improvement, so much so, that the best articles manufactured before we had imported the manufactures of the continent, would, in some branches, be now quite unsaleable.

212. Do you think that that improvement is merely an improvement of foreign articles, or is it creative to a certain extent?—It is generally imitative.

213. You think there is a growing demand for manufactures in which the arts of design are best exhibited?—Undoubtedly.

214. Do you think that the taste of the country is so improved, that articles which were current and fashionable articles some years ago could not now be sold?—Yes, but that fact may arise from various causes.

215. Does not the fashionable taste in itself require a better system of art; that is, is the fashionable taste improved?—Undoubtedly.

216. Have you not had occasion yourself frequently to suggest improvements to British manufacturers?—I have had occasion not perhaps to suggest any particular improvement, but I have urged upon them from time to time the necessity of making improvements generally, and of improving the quality and style of their goods.

217. Do you find any particular disposition on the part of our manufacturers to spend money for the purpose of the application of art to their manufactures?—I hear on all sides their objection that they are not protected, and that if they were to expend money on patterns, they would only be doing it for the benefit of others.

218. Are you aware that in some of the manufactures of France in which art is most expensively applied, that the absolute outlay of capital is ten per cent. upon the production?—I am not aware of the exact proportion, but I know it is very considerable.

219. Is there not a class of individuals in France who are a sort of consulting manufacturing professors, persons to whom the manufacturers are in the habit of applying with reference to the formation of colours?—I believe there is.

220. Do not you think that such a class of persons would be very desirable in England?—Most desirable.

221. Is not Clement Desormes one of those persons?—Yes.

222. If there were a class of intelligent chemical professors, such as Clement Desormes and others, who were habitually consulted by manufacturers as to the means of improving colours, and the application and advantage of chemical arts to manufactures, do not you think that would be exceedingly useful?—Yes; at present the manufacturer does not employ artists to design, for the reasons I have given, and probably for the same reason he does not lay out his money in chemical skill.

223. Do not you think that the ignorance among manufacturers as to art generally has been a great impediment to the introduction of chemical knowledge in the manufacturing field?—There is no doubt of that. But I should say that that is owing to the deficiency of scientific education among the middle classes, in which France, it is generally understood, is so superior to us .I should also state, that the new colours, as well as the new patterns, originate in France. We have a vast number of colours now in our manufactures which were quite unknown a few years ago, and there is scarcely one of them which has not been originally imported from France; that, however, is partly owing to the fact that the fashions are set there.

224. Did you ever hear an expression of surprise from the French manufacturers as to the great superiority of our manufactures, as far as regards the mechanical skill, and our great inferiority in the chemical arts and the arts of design?—I have frequently heard such an expression.

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225. The system in France in most cases is this, is it not, that the central government shall allocate out of the general fund a certain sum for the schools of art, and the municipalities should furnish the deficiency?—Yes.

226. Do you think that would be convenient in this country?—I think it would, at least in the commencement; but I doubt whether it would be necessary to permanently continue any annual allowance to them.

227. As far as your observation goes, do you not believe that the principal manufacturing towns have a strong feeling on this subject, and would be willing to co-operate in it?—I believe they have a very strong feeling, although it has not been expressed to Parliament very strongly before; but this is mainly owing, I suspect, to the hope they have clung to of getting foreign manufactures in some branches again prohibited.

228. Are you aware whether they have represented in any petition to Parliament, with respect to our manufactures, that they are inferior in pattern and design to the French manufactures?—I have seen it stated in a petition from Foleshill, near Coventry, where the ribbon trade is extensively carried on, that they are deficient in that respect only, and praying for some encouragement or assistance.

229. Are you aware that funds have been lately raised in the town of Nottingham for the special purpose of establishing a school of art?—I have not heard of that.

230. Are you aware that the Mechanics' Institutions in different towns have devoted a certain portion of their funds for the encouragement of art and the encouragement of design?—I am aware of it, but I have doubts whether in the present state of things in this country they would find persons competent to teach them.

231. Is there not at present on the part of the manufacturers a much greater disposition to acknowledge their inferiority than existed some years ago?—I think there is, and indeed it would be impossible for them to deny it, because they all copy from the French.

232. As the honourable Member has stated that he thinks it important that the invention of patterns should be protected, could he suggest to the Committee any machinery by which that object could be accomplished?—The only mode which has occurred to me is that of copyright, depositing a model or pattern of the article to be protected in some public office.

233. You do not think that the exceedingly cumbrous machinery of the patent office could be applied to the protection of patterns where the value of the copyright is so transitory?—I am not acquainted, in detail, with the mode of transacting business at the Patent Office.

234. One of the most important results to obtain is rapidity in the recognition of the right, and economy in obtaining the monopoly of it; is not that so?—Yes, and for that purpose it appears to me that we want some sort of tribunal which should adjudicate upon questions of that sort.

235. Do you not think that local tribunals, composed of masters and men, might be conveniently and usefully introduced for the protection of patterns?—For all matters connected with disputes about wages, and the good or bad workmanship of the operatives, I think a union of the masters and men would be very desirable; but I do not see in questions relating to rights of pattern, which are questions between master and master, that the introduction of the labourer is necessary, or that it would be convenient.

236. But if the labourers were intelligent labourers, and instructed as you propose to instruct them by schools of art, would they not be important persons to whom questions as to the valuation of copy-rights might be referred?—I think they would be very good witnesses as to what was or what was not an infringement of a patent; but I am afraid that some years must elapse before we could see them sufficiently well educated, either in art or general education, to act as judges on the subject.

237. Did you ever hear it stated by French manufacturers that they have received important suggestions for the improvement of patterns from the hand-loom weavers?—I have, and I recollect a circumstance which was mentioned to me some years ago at Paisley, which showed in a very striking manner the advantages

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tages derived from the superior education of the working classes in Scotland; a manufacturer there showed me a piece of goods copied from a French pattern that he had put to work; the weaver, after making one or two pieces, applied to him and suggested an improvement, by which the wages were reduced 25 per cent. upon the manufacture of the article; and I would observe that that article was one with which we came into competition with the French manufacture in our market.

238. Do you not think that the inferiority of our English artists is in some degree owing to the want of demand by the public for those improvements in manufactures?—Certainly not; on the contrary, the public very willingly give very high prices for foreign articles, and they would, I have no doubt, purchase English manufactures at the same prices, if we possessed similar excellence in art.

239. Do you think that their taste is concerned in the preference, or do they not very often select from foreign articles those articles which are inferior in point of art, though they may be for the moment attractive in point of fashion?—I very much doubt whether that preference is given for foreign articles, merely because they are foreign; I think the public are always ready to purchase our own goods when they are really equal to foreign.

240. Do you not think that if foreign articles evince a superior degree of taste, they are immediately preferred in this country as well as abroad?—Undoubtedly.

241. You think that in proportion as you extend the taste of the community, that of course there would be a greater demand for those articles in which taste is evinced?—Certainly.

242. The great mass of the community in this country, not merely the lower and the middling classes, but a great portion of the upper classes, have not had their taste proportionately cultivated, in proportion to their education; is not that the fact?—I believe that that is the case.

243. Do you think that that arises from the want of opportunities for the cultivation of that taste, such as the deficiency of public institutions, libraries and museums, and public galleries, or do you think it arises from the neglect which is shown to that department of education during the course of their studies at college and at school?—Much is owing to the want of what may be called elementary education at schools and colleges, but it is chiefly because fine examples of art are not constantly before their eyes; a kind of education that is perfected in rather an adult age.

244. Did you not find on the continent, particularly in Italy, even among those classes that have had very little previous education, and also in schools or colleges, there prevails a general feeling for the arts, and that they with pleasure frequent galleries and public institutions which are open to them by the munificence either of government or individuals?—I have been merely a traveller in Italy, not a resident there, but one cannot even pass through a town without being struck with the regard and respect they entertain for art, and the great love they have for it.

245. If public galleries and public institutions and public museums were open more generally to all classes of people in this country, you think that a very strong feeling for art would be gradually generated, do you not?—I think it is already generated to a great extent in this country among the upper classes, and we owe much to those gentlemen who have supplied the exhibition at the British Institution from year to year; the National Gallery has been very beneficial, and the improvement of our street architecture has also been very useful.

246. Do you see that improvement in taste evinced not only in the capital, but in other parts of the empire?—Undoubtedly. In the course of some recent visits which I have paid to different parts of the country, I have been very much struck with the improvement in our provincial towns.

247. Would you have the goodness to state some of the instances that have come under your observation, in which that improvement has been the most remarkable?—Birmingham and Liverpool particularly.

248. Do you think that in order to disseminate generally a feeling for the arts among the middle and lower classes, one of the first essentials would be cultivating to a more considerable degree that taste in the higher classes during their college education?—

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education?—It may be doubted whether Oxford or Cambridge ever can become a good place for the study of the fine arts.

249. In order to diffuse this love of art among the middling classes, would you not recommend that the cultivation of drawing, for instance, should form, to a certain degree, a portion of their education?—Undoubtedly; the use of the pencil cannot be introduced too early.

250. Would you extend that to elementary education; to elementary schools, that every child should learn a certain portion of drawing?—I think that might be useful, and it would be the more readily ingrafted hereafter in the systems of our popular schools, but I doubt if we are prepared for it at present.

251. You are aware that it has been introduced in Germany and in Switzerland, are you not?—I have understood so.

252. Do you suppose that there is any thing so distinct in our organization from that of other countries, that would preclude its introduction from our elementary schools?—I should say, on the contrary, it is better suited to a dense population and a great manufacturing people.

253. Would it entail any additional expense in education, the introducing of such a system?—I should answer not, if our teachers had themselves been educated for the purpose.

254. Is it not your opinion, that it would be an excellent thing both for the artist and the consumer of works of art, to make art to a certain extent a part of elementary national education?—I should say it would be very desirable, and especially in our manufacturing towns, but until we have schools where teachers may be formed, it would be impossible, I think, to commence a thing of that kind with effect.

255. Is it not the fact, that some time ago French papers were introduced to a great extent?—Certainly.

256. And has not that introduction diminished since our artists copied their patterns; that is, with respect to paper hanging?—That I have no doubt is the case. It is certainly the case in most of our printed articles, that as our taste improves, so does that of our manufacturers, and there is less demand for foreign productions.

257. Are you aware that the importation has diminished since the patterns previously introduced have come to be copied in England?—I have no doubt that such must have been the case, although I have not particularly inquired about it. But I should say generally as to manufactures with which I am better acquainted, that our manufactures have gradually supplanted one foreign article after another, till now the importations are confined merely to the novelties of the season, and these, as soon as our manufacturers copy them, cease to yield a profit upon the importation.

258. Are there not a great number of branches of art connected with modelling, where a degree of education is required?—Undoubtedly.

259. And therefore it is impossible that in those branches of art, without giving the education, we should have the benefit of the designs of other countries?—Certainly.

260. Does it not require a degree of previous education to appreciate the beauties of the higher branches of art?—Unquestionably.

261. Therefore is it not your opinion that an uneducated man sent into a gallery of works of the higher orders of art would be capable of appreciating them?—Undoubtedly,—in the higher branches of art.

262. Therefore the establishment of museums and galleries would not be sufficient to effect that purpose, but it would only be an accessory; is not that the case?—It certainly, alone, would not produce that effect; but as there must be much talent for art existing, such exhibitions produce, perhaps insensibly, very considerable effects; they operate, directly or indirectly on the public mind, and I have no doubt diffuse benefits through all the different grades of society.

263. Can you inform the Committee whether in that species of education which has been alluded to, modelling would not be a very important part, as well as

 drawing?—

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drawing?—It is absolutely necessary; and I understand partly to supply that want, that in the institute of British architects they propose to establish an institution of that kind.

264. Are you aware of the fact, that the *formatore* in this country are, without any exception, foreigners?—I have understood that foreigners are generally employed in casting figures; whether there are any English or not, I do not know; but I believe that we are very much indebted to Italians for the diffusion of a taste for art among the middle and lower classes.

265. Do not you think that the style which now prevails, and has lately prevailed a good deal in this country, which is called the Louis Quatorze style, that a good deal of its success is attributable to the want of skill in our designers?—I do; and whilst I think it is an evidence of the disposition on the part of those who have the means to expend their money on such articles, I think it probable that they would have spent the same money upon what may be considered a better style, if they had had the opportunity afforded them.

266. Do not you see a general preference given by the upper orders to that style of art, even when they may select from either Gothic or Greek specimens, that they still prefer the style of Louis Quatorze?—I think that that is a fashion which is passing away.

267. You stated that you observed a considerable improvement in the taste displayed in our public buildings in the streets?—I did.

268. Do you think that that taste has been well directed?—I should offer an opinion upon that subject with a great deal of hesitation; I should say it has not; but undoubtedly it has produced an effect very superior to what existed before.

269. Do you consider that it is quite unnecessary that those people high in authority who have the superintendence of those buildings, should know any thing of the art which they are called upon to direct; do you not think that it would be an advantage rather that those people high in authority who have the direction of those monuments, should know something of the art that they are called upon to preside over?—I think it very important that we should have responsible public officers to take charge of our public buildings; that supposes, of course, persons duly qualified.

Veneris, 31° *die Julii*, 1835.

WILLIAM EWART, ESQUIRE, IN THE CHAIR.

Mr. *Samuel Smith*, called in; and Examined.

Mr. *Samuel Smith*.

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270. YOU are of the well-known firm of Harding, Smith, & Co. of Pall Mall, are you not?—Yes.

271. Have you not had very extensive means of acquaintance both with English and Foreign manufactures?—We have been a good deal confined to the fancy trade.

272. Has your experience led you to observe that there is any marked distinction, in that part of manufacture which relates to design and art, between the foreign and English manufactures?—In the finer description of fancy goods, the French taste prevails certainly to a very great degree.

273. To what do you attribute that prevalence of French taste?—I attribute it principally to the want of artists and schools of design. In this country the manufacturers have no means of obtaining designs excepting by copies from the French for the most part.

274. Do our artists copy much from the French?—The manufacturers I think copy very much from the French.

275. Is the extension of a knowledge of art among the manufacturers made more a national object in France than it is England?—I should think it is, inasmuch as I have visited artists myself in Paris, where I have found as many as six or eight clerks under one employer.

Mr. *Samuel Smith.*

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276. Can you inform the Committee whether or not French manufacturers do not, at occasional intervals, attend in London with patterns for your trade?—It is usual at the present season, and also about January. We are waited upon by the manufacturers of Lyons, or their agents, which is the same thing.

277. They bring you patterns for the season, do they not?—For the approaching season. It is usual for them to bring us patterns, some drawn upon paper, but the majority a portion of goods absolutely made; these will extend probably to 200 designs, in different fabrics.

278. Do you mean 200 designs in the article itself?—Comprising silk ribands and various descriptions of fancy goods; I am speaking in round numbers.

279. Is the cartoon full of designs?—The cartoon is merely the book that contains them. They bring a book of patterns, which will contain at least 200 designs.

280. What proportion of those designs is of the article itself?—I have already stated that the greater portion are absolutely manufactured; but only a small quantity is brought here, with the intention of being exhibited as patterns. What proportion is afterwards made will entirely depend upon the orders the agents may succeed in obtaining.

281. How many English patterns are submitted to you by the English manufacturers in the same period?—The English manufacturers experience much difficulty in this respect. They more commonly ask us for designs or patterns, or if we know what the French are likely to produce. We have very few, and sometimes none, submitted to us by the manufacturers.

282. Then the difference is, that in general the French manufacturers submit designs to you, and on the other hand you submit designs to the English manufacturers?—Yes; there is another disadvantage the English manufacturer has, if he shows you any thing, it will perhaps be merely an indifferent paper drawing; whereas the other produces the thing itself, and we see the thing absolutely made, which is a great advantage to a person who is not a manufacturer, because he cannot judge from the drawing.

283. Then in the French designs, the greater proportion are patterns of the articles themselves?—Yes.

284. Of the English designs, the greater part are mere paper drawings, by which of course the dealer cannot judge so well of the effect of the pattern as when the article is itself produced?—Exactly.

285. What is the proportion of plain French silks which are sold by you?—Speaking of "plain" goods, I should think our sales are probably quite two-thirds English, and one-third French.

286. What is the proportion between the English and French figured and fancy silks which you suppose you sell?—Figured and fancy silks, I should say that better than one-half were French, and the quantity of French sold consists of the articles of the best quality and the richest designs; the more common-place ones are of English fabric; the articles of higher taste and more expensive are French.

287. What proportion of the finer fancy goods are French, and what English?—They are almost exclusively French; but as the lower descriptions are in more daily consumption, it brings up the quantity of English to be nearly proportionate to that of the French; but the higher description is decidedly French.

288. You are speaking now of silk goods, are you not?—I am confining myself entirely to fancy silk goods.

289. What proportion of fancy ribands which you dispose of are English, and what French, do you suppose?—There the superiority is very great in favour of the French; I should say, three-fourths of what we sell are French.

290. Now with respect to shawls, what proportion of the shawls do you suppose are English, and what French?—There have been considerable changes in the manufacture of shawls within the last few years; at the present moment, the great consumption of shawls here is French, to the exclusion of what we formerly called the Edinburgh and Paisley shawls.

291. What has been the effect of the foreign shawl trade on the English shawl trade, within your recollection?—I am speaking now of a very recent period; it is within four or five years; the Lyons and Nismes shawls have caused that.

292. Are these shawls of the same fabric?—Yes, the same fabric as what is generally known as a Scotch shawl. The Scotch shawl trade has been very much injured by the introduction of the French shawls within the last few years, which I think is greatly owing to the superiority of the pattern and design.

293. Is

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293. Is the material the same?—Yes, it is generally the same; our shawls were generally made with a border sewn on, which was repeated year after year in a Scotch manufacture; the French, on the contrary, have launched out into a variety of designs, extending all over the shawl.

294. The finer shawl trade is nearly annihilated by the introduction of French shawls of superior design?—Yes.

295. Are you aware of the peculiar pains the French take in their designs of shawls?—I have not, except from having read extracts from a work which I shall be glad to refer to.

296. Will you refer to the remarks, and give us the substance?—I would refer, as an instance of the extreme pains the French take, to the following extract from a work, entitled "L'Industrie; Recueil de Traités Elémentaires sur l'Industrie Française et Etrangère:"—"Le dessin nouveau, proposé pour les châles par M. Couder, est, chez lui, le produit de longues études qu'il a resumés dans une brochure fort intérressante, et qui n'est pas moins digne d'attention que les dessins eux-mêmes. M. Couder, soumettant à une analyse attentive et ingénieuse ses dessins si bizarres et si confus du Cachemire indien, a pensé que leurs formes, continuellement anguleuses et brisées, étoient bien plutôt un resultat de fabrication qu'un produit d'art. L'étoffe du Cachemire étant croisée, il s'ensuit que dans une fabrication imparfaite, comme l'est celles des plus beaux Cachemires indiens, l'ouvrier transforme continuellement des dessins arrondis et gracieux, en lignes droites et contournées, qui altèrent la pensée du dessinateur, au point de nous l'apporter complètement méconnaissable. Une fois sur la trace de cette idée, M. Couder a fait des recherches plus précises, et par des rapprochemens simples autant qu'ingénieux, il a donné à sa découverte toute la rigueur de la demonstration. Nous reproduisons (Pl. 16. 2. 3. 4. 5.) quelques-unes de ses comparaisons entre les dessins actuels des châles de Cachemire et les dessins originaux des artistes persans. La seule inspection de ces dessins suffit pour montrer toute la justice de l'assertion de M. Couder; savoir, que les dessins actuels des châles de Cachemire, ne sont rien autre chose, que des dessins alterés par des ouvriers ignorans et sans goût, étrangers autant qu'insensibles à la beauté des formes."

297. Now supposing the French manufacturer wanted to have a pattern, what facility would he have in procuring it?—I have not been in Lyons myself, but I understand there are persons there whose profession is design, and also in Paris.

298. Do you recollect some very beautiful shawls that used to be made in the vicinity of Stockport some few years ago?—They were the first shawls that we used to term "imitations of India," which were made by a person of the name of "Cowderoy;" they were made entirely of spun silk; but the fabric is no longer in use, and has not been for the last ten or fifteen years.

299. They have now ceased to be made, have they?—Yes, for many years; they were made entirely of spun silk.

Mr. *Benjamin Spalding* was then called in, and Examined in the presence of Mr. *Smith*, as follows:

Mr. *B. Spalding.*

300. To Mr. *Spalding.*]—WHAT business are you?—I am the buyer of Messrs. Harding & Smith in Paris.

301. To Mr. *Spalding.*]—Suppose a French manufacturer wanted to have a pattern in France, what facility would he have of procuring it?—There are people who are in the habit of drawing patterns for manufacturers, who are likewise acquainted with the working of the pattern, which is a facility they have not in this country.

302. To Mr. *Spalding.*]—You consider it is one of the advantages of the French system, that the drawing is made by a practical man, do you?—Yes; he is likewise a practical manufacturer.

303. To Mr. *Spalding.*]—In France, the manufacturer has also this advantage, that his practical manufacturer, who makes the drawing, is also a well-educated artist?—Yes.

304. To Mr. *Spalding.*]—Suppose an English manufacturer wanted to have this advantage, what facilities would he have?—There is a great difficulty in getting a pattern for a work in England.

305. To Mr. *Smith.*]—There are, however, pattern-drawers of course in England?—There are quantities.

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306. To Mr. *Spalding.*]—What are the difficulties of the pattern-drawers?—I think the great difficulty is, that they have not been sufficiently acquainted with putting the work into the loom; but that would only apply to silks or shawls.

307. To Mr. *Spalding.*]—Do you consider that the English pattern-maker is defective in a knowledge of the mode of putting his pattern in the machine?—Decidedly so.

308. To Mr. *Spalding.*]—Is he also inferior in a proper knowledge of the art of Design?—I should say he was decidedly.

309. To Mr. *Spalding.*]—Have you ever observed that there is a great superiority on the part of the French manufacturer in the combination of his colours?—Decidedly.

310. To Mr. *Spalding.*]—That is, the combination of the colours is so adjusted, that they please the eye more in the French manufacture than in the English?—They are better blended in the French manufacture than in the English.

311. To Mr. *Smith.*]—Do you consider that the French dies are superior to the English?—I should say, for the most part, the French are more brilliant, but many of ours are more permanent.

312. To Mr. *Smith.*]—Will you have the goodness to mention in what particular colours you think the French are superior, and in what you consider we are superior to the French?—I should say we are superior to the French in blacks, greens and violets.

313. To Mr. *Smith.*]—Then you think in those colours the English are superior, do you?—Yes.

314. To Mr. *Smith.*]—And in what do you think the French are superior?—I do not know that I can recollect any particular colours in the French, but there is a general brilliancy in their colours; there are some few colours that we cannot equal here, and they produce new shawls of colours that would not have been thought of in England.

315. To Mr. *Smith.*]—Are you aware that any inconvenience has been felt in England, for the want of protection to the inventor of a new design?—I rather think there has; we frequently are at an expense in getting up a fancy article, and it too frequently happens that it is copied in a different quality, which of course is an injury to the manufacturer.

316. To Mr. *Smith.*]—Is there any branch lately originated in France composed of a combination of woollen and silk manufacture?—Yes, a variety of materials composed either entirely of woollen or of woollen and silk.

317. To Mr. *Smith.*]—Is our manufacture indebted for its present eminence to the superior design of the French makers?—There has been altogether in many cases a new fabric by the French, some of which are figured in the loom, but many are printed.

318. To Mr. *Smith.*]—Do we import these fancy articles from any other nation besides France, or do they come from any other nation?—We import them exclusively from France.

319. To Mr. *Smith.*]—We do not import any from Germany, do we?—Only a few plain goods.

320. To Mr. *Smith.*]—Nor from any other country?—Nor from any other country but France.

321. To Mr. *Smith.*]—Do we export fancy goods to Germany?—I apprehend our Bandannas go there, but I am not acquainted with that branch of the trade.

322. *To both the Witnesses.*]—Are there any other facts within your knowledge relating to this subject on which you would wish to offer any observation, or do you think we have gone through that which is material; do you think it desirable, from any practical observation you have been able to make, to establish some schools of design, or that some other similar means should be given to instruct the British manufacturing artists?—[By Mr. *Smith.*] I do, because there are many articles which we are importing from France, which undoubtedly if we were in possession of designs, might be equally well manufactured here.

323. To Mr. *Smith.*]—Would you in that case be able to sell them as cheap as if they were imported from France?—Quite as cheap.

324. To Mr. *Smith.*]—You think the best way to counteract the French superiority, would be by the instructing our manufacturing artists, do you?—I do; I would

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would mention as a fact, and it has often been held as an argument, and rather pertinaciously adhered to by manufacturers, that a French article would sell without reference to its peculiar merit, but merely because it is French; that is not my opinion; in placing fancy articles before persons, which I do promiscuously, that is chosen which is most liked, without the question being put whether it is French or English.

325. To Mr. *Smith*.]—You think the public judge fairly between the two specimens, do you?—Yes, whatever the question might have been a few years ago, it is gone by now, and there is no prejudice of the kind.

326. To Mr. *Smith*.]—Could we compete with the French in lace?—Laces are made all over the continent, and we get the respective descriptions from the different countries, and therefore I do not think it applies.

327. To Mr. *Smith*.]—Can you mention any particular branch of manufacture which is depressed in consequence of the want of cultivation of design?—Broad silks, I would say certainly ribands, and more particularly the shawl trade.

328. To Mr. *Spalding*.]—How is it with respect to gloves?—The gloves are better cut in France; the great proportion of what we term fine gloves that we sell are principally French.

329. To Mr. *Spalding*.]—Do not the French take the measure of the hand better than the English?—There are very few manufactures in which the French excel so much as in gloves.

330. To Mr. *Spalding*.]—Do you trace that to any thing like a knowledge of art in the manufacture of the gloves?—It must be from a knowledge of the shape of the hand.

Lunæ, 3° die Augusti, 1835.

WILLIAM EWART, ESQUIRE, IN THE CHAIR.

Thomas James, Esq., called in; and Examined.

Thomas James, Esq.
3 August 1835.

331. I BELIEVE you are a partner in a wholesale house in the city, which purchases largely of the silk manufactures of Spital-fields and Manchester?—Yes.

332. Also of cotton manufactures?—Cotton manufactures also.

333. Are you of opinion that amongst that class of customers that you principally supply, there has been any increased power of appreciation of the beauty of design or of colour in the fabrics of English manufacture?—The fabrics that I am best acquainted with in our house are silk manufactures; with respect to colour, ever since the introduction of French goods, I think we have had a very considerable improvement in the colours, and in the patterns of the English silk manufacture, particularly in the colours.

334. Have the goodness to state in what particular department of the art of colouring silk has it struck you that the improvement has taken place?—I think that not only in the plainer colours, which may be called prismatic colours, but in those colours which are creations of fancy, the shades have been much more brilliant than we used to have them.

335. Do you think that the power of producing finer colours on the part of our manufacturers has increased, as also that there has been an increased degree of good taste in appreciating the colours?—Decidedly so.

336. I think you said that this improvement has been perceptible since the more free intercourse with France?—Decidedly so; I would say to the Committee, particularly referring to Manchester and Macclesfield, that at the time the country manufacturers came to London to attend the periodical sales of silk at the East India House, it was their custom to come to our house and other houses of our class, and obtain from us patterns of the shades of different French goods that we had bought or imported, and the imitation of these goods and patterns has led to these improvements, or at least has been co-existent with it.

337. Are you of opinion that from the excellence and beauty of our fabric, that if silk was still to advance and become dearer, that the public, so far as you have observed, would always repay that by an increased consumption?—Decidedly so; I think

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I think the difficulty of selling a bad shade of colour, whenever it does occur, is increased considerably on account of the general appreciation of good colours.

338. Has it happened recently that figured silks, silks in which there is more of art and of design employed, has it happened that a preference has arisen in favour of such over plainer silks?—Until the last two or three years the production and consumption of figured British silks was a mere trifle, but within the last year the production and consumption of British figured silks has been very considerable.

339. Are they much better than they used to be; are the figures more perfect and beautiful recently?—The figures are smaller, and I think are more beautiful in form than formerly.

340. It appears to be your opinion, that combining the beauty of design with a certain degree of neatness as well in tint as in colour, that the silk manufactured in England has materially improved?—I do think so. Perhaps the Committee will allow me to state a fact within my own knowledge as to the English manufacturers; formerly they were most apprehensive of the figured silks from France, and the contest in them was thought hopeless, but there is now executing in Spital-fields a considerable order for figured silks for America, where of course they must meet the French under no circumstances of protecting duty.

341. I think the Committee understood you that in the case to which you allude, it is not a speculation on the part of the manufacturer, but proceeds from a positive order on the other side of the Atlantic?—Yes, the result of previous samples.

342. If then the beauty of English manufactured silk goods is so materially improved, from our manufacturers having the opportunity of seeing the French patterns, you would infer, I presume, that there is a still greater capability of improvement if more means of improvement were placed within their reach?—Certainly.

343. Does any thing occur to you as important as affording the means of additional improvement by any particular mode?—I would request permission to be allowed to state to the Committee, that I think a matter of the first importance would be to give to the parties who originate patterns a property in the patterns for such a length of time as would repay the outlay and encourage the production of patterns. The Committee is aware that such a protection is given to the printer. When a pattern is framed on printed cotton, the party is protected by the law in the exclusive right of the pattern for three months, and I would suggest that protection should also be given to patterns framed in the loom.

344. Is it your opinion that that protection could be easily afforded?—We have the example of the French to show that it is easily afforded.

345. Have you at all turned your mind to the process by which that could be best accomplished?—I think that a question of detail, which would require some further consideration; I would rather just state the principle.

346. Can you, from recollection, at all state the French mode?—I believe I gathered it myself from Dr. Bowring's evidence. I am not quite satisfied that the French mode would be the best mode for us; something of the kind might do. There was one fact I wished to mention as showing the influence of taste in extending the sale of manufactures. It will be in the recollection of the Committee that some years ago an India handkerchief was almost the distinguishing mark of a gentleman; every gentleman had one in his pocket. India printed handkerchiefs of very common patterns were sold at from 7*s.* to 10*s.* apiece: now the great consumption of India handkerchiefs is by the importation of the unprinted cloth, and they are printed in this country with English patterns, but the cloths printed in India are now principally sold by hawkers to the lower class of consumers.

347. Recurring to what you have said formerly on the subject of colours, has not the importation of French coloured silks very much diminished?—The importation of French plain coloured silks has very much diminished; in fact it has almost ceased.

348. At first many were imported after the prohibition was taken off?—Many; and I beg to mention a curious fact as to the first importation. The first general conception among the British manufacturers was, that they would be beaten by the cheapness of labour in France: but on the importation of plain silks we did not import more than one piece of black to 50 colours; whereas the general consumption of the country is at the lowest one black to two colours. I mention this, because

because it shows how clearly it was a question of taste: had it been a question of labour, it might have applied to colours as well as to blacks.

349. Will you state what is the case?—There is little importation of either black or colours now.

350. In consequence of the improvement in English coloured silks?—Exactly so.

351. To what do you particularly attribute the improvement in English colours?—To copying the colours from the French.

352. I want to know whether the same observation applies to velvets as to silks, in regard to colours and design?—Yes, I should think so, decidedly. There is very little, if any, importation of French velvet.

353. The French themselves import velvet from Southern Germany?—I think that is on account of its superior cheapness.

354. Notwithstanding our advances in the designs you have mentioned, are there still other advances desirable so as to enable us to compete with foreigners?—In our figured patterns we borrow very largely from the French. It is very desirable that we should create an original taste here; we are still behind the French in ribands and shawls; we borrow our figured patterns from France in a principal degree.

355. You think it desirable that we should take effectual means for connecting the arts with the manufactures of the country?—Decidedly so.

356. In your opinion is this almost the only thing needed to give the free power of competition, and almost of successful competition, to our manufacturers?—Decidedly so; perhaps the Committee will allow me to mention that, from the decided advantage that we have from China silk and our application of China silk, I do not fear that we shall decidedly beat the French in figured as in plain goods.

357. Are you aware, as an historical fact, that the French Government sent a mission some few years ago into the region of Cachmere both to introduce Cachmere goods, and also to speculate on the production of the Cachmere shawls?—I know it only from report.

Mr. *Thomas Field Gibson*, called in; and Examined.

358. YOU are engaged largely as a silk manufacturer in Spital-fields?—I am.

359. Are you engaged in making velvets?—In making velvets and plain and figured silks.

360. You have heard the opinion expressed by Mr. James, the last witness, as to the improvements made in design and colour in the English silk manufacture since our free intercourse with the French; do you concur in that opinion?—I do entirely. I consider that, previous to the introduction of the French manufactures, our taste in figured silks was very bad; that our trade existed under a very close monopoly, and that there was little application either of taste or capital to the manufacture; and since the year 1826, the period when French silks were introduced, we have improved very materially from seeing the production of French looms.

361. Do you know whether the French invention of 1832 has given any additional stimulus to improvement in our silk fabrics?—I am not prepared to say that it had any immediate effect upon the manufactures; but I think it gave us a much more clear insight into the nature of French manufactures, and so far we have benefited by it.

362. Do you happen to have any patterns with you of the sort you are now making?—Yes.—[*Producing them.*]

363. What patterns are you now making principally?—The description of figured silks which we are now making in Spital-fields are of a very small and insignificant kind; they are not of the large class of patterns. That is the general class of patterns that are now making.—[*Exhibiting one.*]

364. This has been woven, I believe, without the Jacquard loom?—Yes.

365. How do you acquire your patterns principally in Spital-fields?—They are almost entirely copies or variations from French patterns; there is but a very small degree of talent employed in Spital-fields in the production of patterns. We are almost destitute of original taste in that particular department.

366. In reality your patterns that are called British patterns, are the greater part copies, or little more?—Variations from French patterns.

367. Are there persons who devote themselves to the drawing patterns or copying French patterns in Spital-fields?—There are.

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368. What description of persons are they?—They are not persons of any education, and very little cultivation of taste, I should say.

369. Is their attention confined chiefly to the copying French patterns, or other than French patterns?—No, the French patterns are generally given to them by the manufacturers, and they either copy precisely or make variations as the manufacturers or their own taste may suggest.

370. Have these persons been educated as artists in any degree?—I believe not, or very rarely; I am not acquainted with any drawer of patterns who is an educated artist.

371. Do they make a good living by it; is it a thing from which they derive much emolument?—A moderate income.

372. A fair remuneration; how much do they get?—Probably a man may obtain from 100*l.* to 200*l.* a year.

373. A good pattern-drawer?—Yes.

374. Are you aware, or have you any objection to state, what is considered among the master manufacturers of Spital-fields a large or small sum, or an average sum, for paying these men?—It will depend entirely on the nature of the pattern; it generally happens that the person who draws a pattern also prepares it for its being inserted in the loom; so that the price paid to the pattern-drawer includes some operation of the machinery employed in putting it to work.

375. Are you aware that the French profession of artist is wholly distinct from the profession of reducing the pattern to the Jacquard loom, or adapting it to the Jacquard loom?—I am aware of it.

376. You have not stated any sum that is given to these persons, but you say it varies according to circumstances?—According to the description of pattern.

377. And it is also mixed up with a remuneration given for reducing the design to the mould, or cutting the card, which is necessary for the weaving it in the looms?—It is so.

378. The auxiliary branch of the business is purely mechanical, the cutting of the card?—Quite so, an operation of machinery.

379. It is not necessary that a person should be an artist to enable him to cut the card of a pattern?—By no means.

380. If there was, on the one hand, any Legislative protection for patterns, and on the other there were drawers of patterns who were skilful artists, who could draw beautiful patterns, is it your opinion from the consumption and appreciation by the public of beautiful works of art as applied to silk manufacture, that the master manufacturers would be enabled to give larger prices for patterns, and to have specimens of greater beauty, and consequently to encourage a better description of pattern-drawer than we have at present?—It is quite my opinion; I think that the two difficulties under which we labour at present, are, first, that we have no protection for patterns, so that if I make an outlay of from 20*l.* to 100*l.* upon a pattern, it may be pirated to-morrow by my neighbour, and I should have no compensation for it; and the second difficulty is, that we have no national taste in this department of art, that we have no originality in design in drawing of patterns, that we are compelled to make copies from French patterns in order to supply the demands of our customers.

381. Then from what you have already said it is also your opinion that a school of arts open to persons connected with the manufacture of the country would be of high value and importance?—I think it would be of the greatest importance, coupled with the protection of patterns; but without a protection of patterns, no school of design would be of any advantage to us.

382. The two instruments for encouraging the improvement of patterns are instruction and protection?—Yes.

383. Does any thing occur to you which you think would be useful to the Committee, as to how the machinery of this school could be best managed?—I think I can only refer to Dr. Bowring's evidence as the gentlemen who have preceded me have done. Some such plan as that adopted in France would be the best for us.

384. Do you think, for instance, that there would be a disposition in the master manufacturers to contribute to any such establishment or institution?—Yes; I feel quite convinced that it is not to be expected that the master manufacturers would undertake any part of the expense of such an establishment. That the utmost that could be expected from them, would be to give their time and attention to the arrangement and working of the system; and I believe the fact is, that in France the

the government, or the municipal authorities, or both together, do pay for the whole cost of the establishment.

385. You have stated, that there is a great improvement in the national taste; do you attribute that to any other circumstance than the introduction of foreign manufactures, which show a superior taste?—No; I do not attribute it, in our particular branch of the manufacture, to any other circumstance.

386. You have mentioned, too, protection to the inventor, the instruction of the artist, and the spreading of knowledge in designs among the manufacturing population; do you think having galleries and giving people every opportunity of seeing beautiful specimens of art, and useful means of encouraging taste in design, would be of service?—I am of opinion that if the general taste of the nation was improved it would be beneficial to our manufactures; and I would add that ours is a manufacture which is capable of such extreme variety in shades of colour, in the blending of shades, and in producing various forms of pattern, that there is hardly any one to which the exhibition of all works of art in which colours are concerned would be more beneficial.

387. For how long a period do you think it necessary to leave a protection for patterns?—I think not less than 12 months.

388. You are aware that the protection at present for printed cottons is three months?—Yes. I am also aware that there is a complaint that the protection is not sufficiently long.

389. Would you not think it sufficiently long if a pattern was protected during a season, either the spring or winter season, for six months?—I can give a reason why this would not be a sufficient time. I was manufacturing a pattern in silk during the spring, to the order of a large house of business in London. I received orders from them to continue the manufacture of the same pattern in autumn colours; but in the last month this pattern was taken to Manchester and manufactured there. The order which I had received for the winter article was immediately countermanded, because it was produced at Manchester at a much less price.

390. You have stated that you get most of your ideas at present from the French; have you not regular pattern-drawers in the silk trade?—I have already stated that we have.

391. Suppose a means could be found of creating a tribunal of taste in regard to patterns, what species of penalty would you apply to the infraction of a copy-right?—I think a fine might be made sufficiently heavy to deter piracy. In France there is imprisonment also.

392. In France they have the power of imprisonment for three days, and of fining to the amount of, I think, about 8*l.* sterling; do you think that penalty would be sufficient?—By no means.

393. Would you not also recommend the seizure of the goods of which the copy-right had been pirated?—I should prefer to make the fine considerably heavier, and I believe I shall be borne out in this from what takes place in the cotton trade. It has always been found that an injunction in the Court of Chancery has been sufficient to protect a pattern of printed goods.

394. There would be no objection to give a body, constituted for the purpose of protecting copy-rights, a power of fining to any extent, supposing there was an appeal?—I should say no objection.

395. Is it not important that the remedy for infraction of patent right should be cheap as well as summary and prompt?—Most decidedly so; if it did not combine the two objects of cheapness and promptitude in protection to the patterns, it would be quite ineffectual.

396. Is it not the case that sometimes there are more than 100 pieces of the same pattern?—It more often happens that there are less than 100; more often than not.

397. According to the average returns from the Chamber of Commerce at Lyons, the number of pieces made of fancy goods of particular patterns does not exceed 20 from the frame; what is the average production of England of the same manufacture?—I have no precise knowledge of that; I should say double; at least 40.

398. Are you aware of the fact, that in some cases a very large profit is paid to manufacturers on condition that they shall produce a small number, and then destroy the design?—That does not take place in this country.

399. Have you heard that that is very frequently the case in orders given for French silks?—I have.

400. Supposing a protection to be afforded to a pattern, how would you have it

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effected; for instance, in a pattern to be made ready for sale to-morrow, what protection would you afford to it before it went into the market?—By registering the actual pattern.

401. Would you have something put at the end to signify that it was an engaged pattern for a specific time?—I think that registration would be a sufficient protection.

402. With regard to printed goods, the custom is for the parties to print on the end, "engaged for three months," and after that period it may be copied by any body; do you think that would be a sufficient protection?—I think it would be so, if it was extended, as I said before, to 12 months; whatever registration took place should be a public and authentic one.

403. Would not the registration and location of patterns, representing the state of protection in the particular trade, be in itself a great means of advancing and improving the manufacture?—I think it would be influential.

404. Would you have a central place for registration?—I think that would be questionable.

405. Do not you think the simple mode adopted in printing cotton, of having written on or woven at the end of the piece, "registered on such a day," and sending a copy of the pattern to an office with that statement, would be sufficient?—I think that would be a sufficient protection.

406. You have the intimation that it is an engaged pattern, and if it is doubted, reference can be made to the register at the office?—I think that would be a sufficient protection.

407. Has the system of registration adopted as to printed cottons succeeded?—I believe it has succeeded entirely.

408. The number of printed cottons is very large, and it is said that the average production of fancy silk goods is very small; do you think the cases are quite analogous?—I am not aware that this circumstance would affect the case in any manner.

409. Is the stamping the piece itself any security?—I am not prepared to say that stamping is necessary; simple registration of the actual pattern, with the date, would be sufficient protection to any manufacture.

410. Are there in this country any superior weavers who are solely employed in the weaving of patterns?—There are not, and there is a good reason why this is so; a weaver could not himself produce the pattern to the manufacturer in the same way as he does at Lyons, because in London he is not possessed of machinery by which he could do it; the machinery belongs to the master manufacturer here, but in Lyons it belongs to the weaver.

411. Does it not frequently happen in France, that after the design has been produced, the weaver introduces a considerable modification into the pattern itself?—I have heard it so stated.

412. And have you also heard it stated, that a great many patterns produced by the artist, and worked by the pattern-weaver, are not brought into the market, as they are considered to have failed in the experiment?—Yes, I have heard that it is so.

Mr. *John Howell* and Mr. *Robert Butt*, called in; and Examined.

Mr. *John Howell* and Mr. *Robert Butt*.

413. Mr. Howell, you are a partner in the well-known firm of Messrs. Howell & James, Regent-street?—Yes.

414. Mr. Butt, are you in the same establishment?—Yes, I am principal manager of the bronze and porcelain department of Messrs. Howell & James's establishment.

415. Mr. *Howell.*]—Of course you are extensively acquainted with the subject of patterns; will you have the goodness to lay before the Committee any information that you possess upon that subject?—A question was put to the last witness, as to the manner of choosing our patterns or goods; it is usual for the Lyons manufacturers to come twice a year to England, that is, in the spring for the autumn, and the autumn for the spring, and they produce perhaps 200 or 300 patterns, not paper patterns, but silk patterns or gauze patterns, or whatever it may be, and from these patterns we make our selection; and it sometimes happens that we have so good an opinion of certain patterns, that we say, "Now you must withdraw that, it must be made for us only," and for 20 or 30 pieces they will do that. Now the English manufacturers never give us that advantage, they think it very expensive to put to work a pattern to show us the effect of it, for it looks so different on paper to what it is in reality, that we cannot decide whether

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whether we shall have it or not, and we often urge them to bring us a little piece ready, to see the effect of it; sometimes we want colour, sometimes we want a little change in the disposition; but there has always been an objection to the expense incurred, and therefore we are obliged to bear the expense if we are content to order from a paper pattern; we have sometimes found it necessary to ask for a pattern-drawer or designer; not a pattern-drawer, because they are distinct businesses.

416. Do you mean in England?—Yes; I never found a good designer in England; a pattern-drawer is a different thing altogether; he is the man who puts the thing comparatively to work, as an architect designs the building of a house.

417. You say you found it very difficult to procure a good designer in England; is it equally as difficult to find a good pattern-drawer?—I cannot procure either; you must have attached to the establishment a pattern-drawer as well as a designer; a pattern-drawer is the man who puts it to work.

418. But you can get neither of them?—No.

419. Neither a good pattern-drawer nor a good designer?—No; the designer gives us a small pattern, and the pattern-drawer is the person who prepares the work; as an architect gives a drawing to the builder, so does the designer to the pattern-drawer.

420. You mean by alluding to pattern-drawers, if I understand you correctly, that persons cannot construct a loom so well in this country to work a pattern, as they can in France?—I think there are not so many persons that are capable of doing it in this country as in France.

421. That is the department of weaver?—Yes; but I believe there are persons present who will give better information on that point; I understand the pattern-drawer and designer, one depends upon the other; the pattern-drawer is the medium between the designer and the weaver.

422. Have you any other observations to offer on the subject of patterns?—Nothing material.

423. Do you consider that the French figured and fancy goods are superior in design to those produced in this country?—After the Peace with France, I found the manufactures of France were superior to those of England; I mean in regard to silks of all descriptions; but I think a great deal of that arose out of having made use of better material; the natural silk of France has been considered better than any other country, but now we have an importation of that natural silk, and it is manufactured here.

424. Do you think the importation of raw silk from France, by reason of its superior quality, has beneficially acted upon the English manufacture?—I think it has; I found their silks better the moment I had an opportunity to go and see them; but I have found them declining every day since; every time I go to France I find the French silks are not so good as they used to be in point of material and workmanship; they appear to be desirous of a large trade rather than a small good trade; the English manufacture has improved in a greater ratio perhaps since then.

425. Confine the question to design, not to material or workmanship?—France is superior to us in design; they continue to be superior; but it is confined to very few houses; there is only one house at Lyons we can deal with largely, because their taste is always superior; I am speaking of design.

426. Has there been a great improvement in English colours of late years?—I think there has.

427. And a general improvement in all arts and productions?—Certainly.

428. You have just said that French manufactures are declining with regard to superiority; do you consider that to proceed from the increased competition offered by this country?—I think it is from less encouragement given by this country; it has been very little, compared with the improvements; two-thirds of the silk we are now selling are English

429. You have also mentioned that the French fabrics are superior to ours; are you aware that there are schools of design in France for the education of persons?—I have understood so.

430. Do you not know that the superiority of design is produced in a great measure from the encouragement given to learn designing as a matter of art?—That is my opinion.

431. Suppose in France you want to engage a pattern, and you give an order for

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for 20 or 30 pieces, do you pay a price in proportion to the quantity you take of it?—I presume they put a per centage on it in the first instance; the patterns are brought ready made.

432. Have you had occasion to find it your interest to get French patterns copied by manufacturers in this country?—Frequently, with a little variation; in fact, we keep all our patterns; patterns 50 years old are very useful to us at this present moment.

433. You get them made in this country because you get them made cheaper than in France?—Yes, without duty; but whether I could get them cheaper or not, I would not send patterns from England to France to be made; I should give the preference to this country as a matter of conscience.

434. The question is, whether you get French patterns made by English manufacturers; that is to say, you buy patterns of a French manufacturer at Lyons, say five or ten pieces, and you find a sale for them all, and wanted more, would you send that pattern to Spital-fields to imitate?—Yes, when I wanted a repetition of it.

435. Do you think it desirable to extend a knowledge of design among the population?—I do.

436. Do you think it wanted?—I think it wanted, coupled with a protection to patterns.

437. The protection to patterns is not only important to the manufacturer, but important to the seller?—Yes; to me particularly.

438. Now do not you consider in another branch of trade, that our designs in jewellery are better than in France?—If the Committee is inclined to commence that subject, I can answer any question.

439. Have the goodness to embody any information as clearly as you possibly can, when you have done with the subject upon silk?—With respect to protection to trade, Mr. Gibson stated a twelvemonth; I should be quite satisfied with six.

440. With respect to the invention of patterns, you think that would be quite sufficient?—Yes, six months; and I think the mere stamping the name on the end of the piece, added to the registering, would answer all purposes.

441. Do you know whether or not the riband trade is improving in this country?—I consider that is a particular sort of riband which the English manufacturer could not succeed in making, is now going out of fashion; the gauze riband de coupé and the other introductions they can make very well.

442. With regard to shawls?—The French machinery of India shawls is superior to any we have in this country, and it has been brought about by Ternaux going to Cachmere, and bringing over with him some of the Cachmere goats.

443. Are you aware that the factory system has been applied to the production of shawls in France?—I am not aware of it.

444. Do the French pay great attention to pattern shawls?—Very great attention; they will give three or four hundred pounds for a Cachmere shawl, or India shawl, for the sake of the pattern.

445. Had you an opportunity of seeing the shawls that were exhibited at the Exposition in France?—Yes.

446. Was there not a universal acknowledgement of great superiority?—Certainly they are superior to the India shawls; the patterns are more perfect.

447. Are you aware that not only has the French shawl manufacture not only improved in beauty, but that there has been an extraordinary diminution in price?—Certainly, even as to the Cachmere materials, there has been a great diminution.

448. A diminution amounting to nearly 60 per cent?—Yes.

449. Can a French manufacturer produce a superior article to the English manufacturer at the same price?—Certainly.

450. Do you attribute their superiority to having a superiority of materials for dying, or to the construction?—No, because we have the same material; I consider it is in the manufacturing part of it; it is not for want of the same materials; I believe, in the first place, greater encouragement is given to the French people in the manufacture of shawls than to the English.

451. Are their patterns superior by superiority of combination of colours, or design?—Yes, in the manufacture, as well as the combination of colours and design, it is all superior.

452. You attribute the encouragement given in France to the superiority of design; are you aware that improvement in the quality and diminution in price

price has led to a great increase of demand in France generally for shawls?—I should consider it had.

453. Are you also aware of the fact, that the importation from the East Indies, which was formerly very considerable, is very much diminished in France, though shawls are now admitted which were formerly prohibited?—I should consider it is diminished very much, and in this country too.

454. Have they a superiority of machinery in the manufacture?—I believe they have, and execution as well. Will the Committee allow me to exhibit some pieces of paper, to elucidate the connexion between silk and other materials, the manufactures of the country? It shows how the introduction of good patterns will give a taste or style to other materials; it is intended for rooms in lieu of silk; and instead of costing two guineas and a half, a yard would only cost 2*s.* 6*d.* The inventors are De la Rue & Company, Bunhill Row.—[*Mr. Howell then produced to the Committee patterns of various colours.*]

Mr. *Robert Harrison*, called in; and Examined.

455. YOU are connected with the respectable firm of Brydges, Campbell & Harrison, silk manufacturers?—I am.

456. Have you been long in that business?—Yes; I have been connected with it for these last 20 years.

457. Has your attention been turned to the superiority or inferiority of the French patterns in the silk trade?—My attention principally has been devoted to the better branches in the manufacturing of fancy silks.

458. In those branches do you find a superiority or inferiority to the English in the designs and patterns?—In designs and patterns we are very inferior to them; and that is the principal difficulty under which we labour at the present time.

459. Do you refer to other fancy articles, as well as silk?—It is silk we devote our attention entirely to; we have not been able to find persons in this country who are capable of giving proper designs; the principal difficulty arises from the circumstance of men not having been brought up in this country to design for silk; it is very different to designing for printers, from the circumstance that it is necessary a man should be conversant with the principle of weaving, before he can make a proper design for silk. If we could only get designs in this country, we should be able to find parties that could put them on ruled paper for weaving.

460. You mean by ruled paper, the paper which goes between the original invention of the pattern and the manufacture of it?—Yes, the person who cuts the cards, according to the construction of our machinery; there is nothing but what we could make, provided we had a proper designer for the purpose of drawing patterns for weaving; and I think the principal difficulty arises from the circumstance of not having any school of art in this country, where young men would be enabled to pursue their studies for the purpose of perfecting themselves in drawing for that particular branch of the manufacture.

461. You think there is no want of talent in the country?—I think there is not; because there are a great many persons engaged exclusively in the production of designs for printed cottons, challis, and bandanas; we have in the trade individuals who can draw patterns, but are not conversant with the principle of weaving, and therefore we have been unable to put those patterns to work. We have now many patterns by us which are perfectly useless, because the drawing is not adapted to weaving.

462. You think, also, that not only the talent of the artist, but the taste of the public, would be encouraged by such good designs, if they really existed?—Undoubtedly; because it is from the superiority of the design that the French have the advantage over us.

463. And you think that the encouragement of knowledge of design, by whatever means, among the manufacturing population, would extend the demand of the manufacture?—Undoubtedly it would; we would willingly, at the present time, engage a man at a handsome salary, conversant with the principle of weaving, as a designer, and also able to put the pattern upon paper.

464. Has encouragement been given to foreigners possessing the best quality and knowledge of design, and superiority in weaving, to come over here?—Two or three have been over here at various times; but we have not been able to meet with individuals capable of carrying on the designing of patterns and drawing also, to the extent we should wish; I imagine those men are able to get sufficient occupation in Lyons or in France, without coming to this country.

 465. Do

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465. Do you consider them to be superior even in original design, in that portion of the manufacture connected with the art, as well as embodying the art of manufacture in the process of weaving?—I think their superiority arises from the circumstance of their having a knowledge of weaving as well as a power of designing.

466. You consider them superior in both?—Decidedly, in designing, from their knowledge of the principle of weaving.

467. Do you consider our deficiency in the means of not having persons in this country to construct designs, and also to have a knowledge of the looms, to be such that you yourself would be anxious to engage foreigners to come over here in that department, provided you could get them? —Yes, I should be very willing to do so. I feel satisfied we could make anything in this country, provided we had proper designers, parties to make drawings, and put the drawings upon ruled paper ready for cutting of the cards.

468. And do you think if such persons did exist in this country, it would be a source of profitable employment?—I think it would.

469. And the trade suffers for want of it?—Certainly, for the want of it. I have one or two patterns with me that we had drawn in Paris, and immediately we got them over here, we had not the least difficulty in putting them to work. —[*The Witness handed in some patterns.*]

470. These patterns are such as you have described already, that have been tried on the loom; and found they would succeed?—We can pretty well judge by the style of drawing, whether it would succeed when put upon rolled paper, that is, if it is done by a person who is conversant with weaving.

471. Do you consider foreigners superior to us in their colours?—I do not think they are; there is a brightness in their colours we certainly do not possess, but I think our colours are more permanent.

472. Do you think we have improved?—The dying of colours has certainly improved within the last few years, and in many cases, the permanency of colours decidedly is more so than the French.

473. Is there not a chemical combination entered into in the different colours? —It is necessary to have a perfect chemical knowledge before a man can be a good dyer.

474. What is the cause of the peculiar brilliancy in the French colour?—I scarcely can answer that question; I understand it arises from the climate more than anything else, and the water has something to do with it as well.

475. Have you anything that you desire to suggest with regard to the encouragement of designs; have you paid particular attention to that?—It has occurred to me, if we had a school of arts established in this country, that a great many young men would be willing to make themselves conversant with the principle of weaving, for the purpose of procuring that particular study, and ultimately to become designers and drawers upon ruled paper for the silk trade.

476. Would it not be a lucrative profession for those young men?—I think it would, decidedly.

477. Have you turned your attention to the subject of protection?—We have often felt the necessity of having some protection for our patterns. Only about four months since, a figured silk made for a house at the west end of the town, about a week after sending the order in we found the pattern copied in Spital-fields; we in fact bought the identical piece of silk copied from the one we had made to a particular order; it was of a very inferior quality, and consequently came to 1*s.* 6*d.* per yard less.

478. Have you turned your attention to the best means of carrying into effect a security for a new pattern?—I am not exactly aware of the system, or rather the plan pursued at Lyons, but I am given to understand that a system does exist there; and I should imagine if we could establish the same principle in this country, it would be the most effective means of protecting us.

479. Do you mean by adopting the marking or registration?—I think simple registration would be sufficient.

480. Have you any other point connected with your own manufacture to offer to the Committee?—Nothing more.

481. Do not you think that registration would be more complete if the piece was marked at the end with the date of registration?—Immediately the piece leaves our hands it would go into a house at the west end of the town, and they would instantly cut off that mark; I do not see any good likely to result from it.

Veneris, 7° die Augusti, 1835.

WILLIAM EWART, ESQUIRE, IN THE CHAIR.

Mr. *George Eld*, called in; and Examined.

482. I BELIEVE you are mayor of Coventry at present?—I am.

483. Have you resided many years in that neighbourhood?—Yes, I was born in Coventry, and I have resided at Foleshill, which is in the county of Coventry, and within three miles of it, for the last 20 years.

484. You are not, I believe, engaged in trade yourself?—I am not engaged in the riband trade.

485. In what trade are you engaged?—In the corn trade.

486. But from your residence in the neighbourhood of Coventry you are acquainted with the state of the riband manufacture?—Yes; I reside at Foleshill which is inhabited almost exclusively by a manufacturing population.

487. You have been an observer of the state of the manufacturing population of that neighbourhood?—Yes; in consequence of the distress under which they have been suffering of late, my attention has been called to the condition of the operative weavers in the riband trade.

488. Have you ever had occasion to observe that the operative weavers employed in the riband trade in that neighbourhood would derive advantage from improved skill in designing patterns, and from a knowledge of the arts?—Such improved skill appears to me to be very much required indeed. In consequence of the public attention having been directed to that subject, I made some inquiry with a view to ascertain the number of persons engaged in the riband trade, and who had any knowledge of the art of design in Foleshill; with a population of 7,000, I could not find more than six persons in the whole parish who were capable of copying a pattern, and not one capable of making an original design.

489. You have made exact inquiries into that subject?—Yes, as far as I have been able to do so.

490. Is there any school of design established in that neighbourhood?—None whatever.

491. Not even connected with the Mechanics' Institution?—Not at Foleshill. At Coventry there is a drawing class connected with the Mechanics' Institution of that town, but it is as yet quite in its infancy.

492. Is that drawing class at Coventry open to every body?—Only to the subscribers to the institution, of course.

493. Have the inhabitants of Foleshill, to your knowledge, ever presented any petition to Parliament connected with this subject?—Yes, they presented a petition in which they prayed for assistance towards establishing a school of design as connected with the riband manufacture.

494. In your opinion is it the general conviction of the residents in the neighbourhood, that the time has come when such establishments would be of peculiar utility in the improvement of that manufacture?—Certainly; I have had frequent conversations with the manufacturers of Coventry upon that subject, and they appear to me to desire such an establishment very much.

495. To what circumstance do you attribute the change which has taken place in the conviction as to the importance of a knowledge of art with reference to manufactures?—I should say from the decided superiority of the French in the taste of their patterns, which has forced upon them the conviction that they must adopt the same means of cultivating a better taste.

496. Has that become a general conviction in the neighbourhood of Coventry and Foleshill?—Yes.

497. Has that conviction prevailed among the operative weavers, as well as the master manufacturers?—Certainly.

498. In your opinion would the operative weavers avail themselves of such means of improving their taste and knowledge of art if those means could be afforded?—Yes, I think so certainly, and I may mention as an instance of that,

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that I was conversing one day with a weaver in Foleshill, and stating to him my wish to see the establishment of some school of design in that neighbourhood; he said it would be a good thing, and the next morning his nephew waited upon me; he said his uncle had mentioned our conversation to him, and he very much wished that something of the sort should be established. He brought with him some patterns which he had made himself, and was anxious that I should assist in setting on foot something of the sort in Foleshill; a register of patterns; or in short, to establish a school of design.

499. With reference to the Mechanics' Institution of Coventry, and the teaching of drawing there, do you know whether the teaching of drawing is accompanied by any instruction as to the transfer of the drawn pattern to manufactured articles?—I do not think it is, but I am not able to speak to that, not being a member of the institution myself.

500. You are aware that that would be a necessary part of the instruction to be afforded by a school of design with reference to manufactures?—Yes, a mere drawing school would be of very little use, unless it was accompanied by lectures on the art of drawing and design, as applicable to manufactures, and as showing the means of transferring the design to the article to be produced.

501. Are you aware that at present new patterns are invented at Coventry and Foleshill?—I think very few original patterns are invented; but not being a manufacturer myself, I cannot speak very accurately to that.

502. You have stated that there is a conviction on the part of the operative weavers that such establishments would be of utility to them?—Yes.

503. There is a willingness therefore on their part to improve their taste and to acquire a greater knowledge of the arts?—Certainly.

504. Do you conceive there is any want of native talent, if properly encouraged?—None at all.

505. In fact, then, in your opinion, it is only doing justice to the natural talents of the manufacturing population to give them the means of acquiring a better knowledge of the art of design?—Certainly.

506. Do you think, if some encouragement were given by Government or by Parliament for the establishment of schools of art in certain districts, that local assistance might also be obtained for the same object?—Yes, I think so, certainly.

507. You think there would be no unwillingness to assist, on the part of the inhabitants of those districts?—I think there would be great willingness.

508. Have you any public collection of pictures at Coventry or Foleshill?—No, there is none at Coventry, and Foleshill is a mere village, with very few opulent inhabitants.

509. Then the manufacturing artist has no external means of acquiring a taste in the art of painting?—No.

510. Is there any museum for patterns at Coventry?—No.

511. Or of machines?—No.

512. Is botany a study at all attended to by the manufacturing weavers?—No; there are some collections of natural history, principally of birds, at Coventry; but I have not heard that they have turned their attention to botany at all.

513. Have they any means of acquiring a knowledge of the effect of a combination of colours?—No.

514. Is chemistry a science which is at all attended to by the operative weavers?—No.

515. Is it not attended to by the dyers?—I do not know.

516. In your opinion is there a sufficient number of opulent inhabitants in Foleshill to establish institutions to promote instruction in the arts among the manufacturing population?—I think not.

517. Is there a sufficient number of such persons in Coventry?—At Coventry I think very material assistance could be derived, not only from the opulent inhabitants, but from the established school in that place. There is a school called Bablake School, which is under the patronage of the corporation, in which I think drawing and design, as applicable to manufactures, might very easily be introduced.

518. Is it your opinion that in this country, as in France, there might be, in addition to the encouragement afforded by the Government, some assistance derived from funds at the disposal of the municipalities, which might be very advantageously applied to the acquirement of that knowledge on the part of the manufacturers?—I think the funds at the disposal of Government would very much assist, with the aid of the local institutions, such as Bablake School, in which, if the boys could

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could be taught the arts connected with the occupations in which they are afterwards to be engaged, it would be very advantageous.

519. At present the arts are not taught in any public or charity school in Coventry?—No.

520. Are you of opinion that if aid were received from Government it would encourage the voluntary system?—Yes; there is no voluntary system at present.

521. Did you not state that there was a Mechanics' Institution?—Yes, but that is not a school of art; that is a mere drawing class.

522. Is not that supported by voluntary contributions?—Yes, but it is not able to carry on such a system of teaching, applicable to manufactures, as can be of any importance.

523. Do you not think that the existence of a drawing class in the Mechanics' Institution at Coventry, is a proof of the willingness on the part of the inhabitants to assist the views of Government in the establishment of such institutions?—Yes.

524. In your opinion, would the assistance that could be given by Government, or from the capital, not only be important in a pecuniary point of view, but also very important with a view to give a proper direction to the study?—Certainly.

525. Are you aware that school-houses are founded now by facilities given on the part of the Government, and not by direct interference?—Yes.

526. Do you think some such plan might be usefully adopted with reference to schools of design?—I think it might.

527. Do you think it might be desirable to have any thing like normal schools to instruct the teachers themselves, and that thus a uniformity of knowledge might be supplied all over the country?—It certainly would be very useful as applicable to the neighbourhood of Coventry.

528. Do you think there should be a central school of art for the instruction of teachers?—Yes, it would be very useful, as it would provide for a general direction of the schools.

529. Would not instructors, taught in London, from the circumstances of the immensity of the population, the number of public galleries, and the habitual intercourse that exists among individuals of all nations, have superior facilities for acquiring knowledge in all branches of art?—Certainly.

530. Would not such persons be likely to be better instructors in the provinces than persons merely educated in the provinces?—Certainly.

531. Have you ever turned your attention to the subject of the protection afforded to the inventions of artists?—I have not, but it appears to me that it is of very little use to teach them to design patterns, unless you protect them in the use of that design after it is made.

532. In your opinion it is necessary to afford that protection in order to encourage the invention of new designs?—I think so.

533. Do you think it would be easy to establish a board or tribunal for masters and workmen, to whom questions relating to the copyright of patterns might very conveniently be referred?—I think so.

534. Is there any other suggestion which you wish to offer to the Committee?—I am not aware of any at present.

Mr. *Robert Butt*, called in; and further Examined.

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535. DO you belong to the establishment of Messrs. Howell & James, in Regent-street?—I do.

536. What portion of that establishment do you particularly superintend?—The bronze and porcelain department.

537. How long have you been in that situation?—About two years.

538. Were you well acquainted with the subject which comes under your consideration there, previously to your being a member of that establishment?—Yes, I have been accustomed from boyhood to deal in such things.

539. In London?—Yes, in the houses of other importers of such goods.

540. Was your experience confined to London, or did it extend to other parts of the country?—It was confined to London.

541. You have not been much to Worcester or other places?—I have not.

542. Has your attention been called, from observation, to the comparative

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merits of the English and French manufacturers, as regards the design in bronzes and porcelain?—It has.

543. What has been the result of your observations upon that subject?—I consider that, with a few exceptions, in metallic manufactures the French are vastly superior to us in their designs.

544. What are the exceptions to which you allude?—I allude more particularly to manufactures in silver, to gold, jewellery, and to castings in iron, in which I think we excel them in design.

545. With regard to porcelain, which of the two are superior in design, and in what branches of the porcelain manufacture?—In some branches of the porcelain manufacture, the French are superior to us in design, in others they are inferior. In that description of porcelain which is of the same nature as the old Dresden china, ornamented with raised flowers, we are vastly superior to them, and a considerable quantity of such porcelain is, I believe, annually exported to Paris, and is sold there, and considered by the French superior to their own.

546. That is the porcelain in which the designs are in relief?—Exactly; but with that exception, their designs in porcelain are superior to ours.

547. Do you speak merely of the designs of the French in fancy articles of porcelain being superior to ours?—Yes, in ornamental porcelain.

548. You do not speak of those articles in porcelain manufacture which enter into the consumption of the great mass of the population?—I do not.

549. Your observation is confined to articles of luxury and ornaments?—It is.

550. Is it entirely confined to them?—Yes; I have little or no knowledge of the other branches of the porcelain manufacture.

551. In your opinion, the French are superior to us in their designs in bronzes and some other metallic manufactures?—Yes. In the term "bronze," we include not only that which is strictly bronze, but all articles cast in similar metal, whether gilt, or-molu, or otherwise, such as human figures, figures of animals, and the ornaments of clocks, candelabra, and so on.

552. You have stated, that with respect to articles of silver, gold and iron, the English are superior in their designs to the French; how do you account for the superiority of the English in the one case, and the superiority of the French in the other?—Because the superior costliness of the articles to which I allude in England, as compared with those of France, enables English manufacturers to give high prices to artists to model or design their patterns, particularly in silver.

553. In fact, the costliness of the article calls into the market a supply of a superior degree of artists?—It does.

554. But with respect to articles of an inferior value, the French are superior to us in their designs, from the greater cheapness of art in that country?—Yes.

555. Then is not the possession of cheap art in England, a great desideratum in the manufacture of those articles of a less costly description?—Certainly.

556. In your opinion, in the less costly articles for which art cannot be so highly paid, there is not a sufficient supply of art at a cheap rate for the purposes of the manufacturer?—There is not.

557. For instance; a silversmith who pays highly for a design, and produces a very costly article, could afford to go to a Flaxman or a Stothard, as artists who could furnish a design; but the manufacturer of articles which come within the range of the less opulent classes of consumers could not afford to employ them?—That is precisely my view of the case.

558. They cannot, from the lower price of the articles, afford to pay so highly for art?—Certainly not.

559. Are not articles in bronze of sufficient importance to require the employment of able designers?—They are.

560. How comes it then that you have stated, that in these articles a superiority exists on the part of the French?—Because, although they are articles of sufficient importance to demand the assistance of art in this country, yet they are not of sufficient importance to demand the assistance of art to be paid for at the same rate as it is for manufactures in silver and such costly materials. I mean particularly to allude to the richer description of silver articles manufactured in England. But similar designs for bronze may be obtained at a much lower rate in France.

561. You allude to articles of luxury and ornaments, articles required by the few, and not for the consumption of the many?—I do.

562. But if iron manufactures will pay for the employment of able designers, how comes it that manufactures in bronze will not?—Because castings in iron, such

as I allude to, that is for architectural embellishment, have a very extensive sale in this country, and we have no foreign competitors in that branch of manufacture, but for bronzes there is not an extensive sale, and we have the competition of the French to contend with.

563. You have stated that the French are superior in the art of design in certain articles; is there any difference in the manner of moulding between the two countries, and do you think the French mould bronzes better than we do?—I can only speak of the superiority of their designs.

564. In the operative process of moulding, in fusing the metal and preparing the mould to receive it, are they superior to us?—I am not aware that they are; I have no actual knowledge on the subject, but I believe it is not considered that they are.

565. To what cause do you attribute the general excellence of the French in the design of manufactures of certain articles?—To the facilities afforded to persons of all classes in France for acquiring a knowledge of the art of design, and the corresponding difficulty to any but persons of comparative independence of obtaining similar instruction in England.

566. Have you been in France yourself?—I have.

567. Have you had an opportunity of observing what advantage results to the French workman from that superior knowledge of design which you have stated he possesses?—The advantage which arises to the French workman from that knowledge of the art of design which the public institutions of France enable him to obtain, consists in the circumstance that he is thereby enabled frequently to make his own designs and models, and if not sufficiently instructed to do that, he is at all events enabled to finish works executed from the models of others with superior accuracy, so as to give them their proper articulation and feeling, particularly in human figures and figures of animals. I may say, in continuation, that this is rarely the case with English workmen; and the advantages which the former consequently possesses are conspicuous in the beautiful figures which decorate the clocks, candelabra, vases, &c. which are imported from the continent, the grace and expression of which (however well modelled by the artist) would be entirely spoiled by an injudicious finishing of the muscles, draperies and extremities by an ignorant workman.

568. Then your answer tends to show that even in copying the French are superior, because the manufacturing population are better educated in art?—Undoubtedly.

569. And therefore, though the workman might not design himself, he has a more correct idea of the object he is to imitate?—Yes.

570. And he has a more correct idea because he is more of an artist?—Certainly.

571. Have you visited any of those institutions to which you have alluded?—I have not; what I have stated with respect to them is not from personal observation, but I speak of them as of a matter of notoriety.

572. But you spoke of the effect as a thing which you yourself had observed?—Yes, and as resulting from what I have always understood to be the nature of those institutions.

573. And you speak positively as to the effect produced in the designs of certain articles of French manufacture?—I do.

574. In your opinion, in that particular manufacture of bronze, the French very much excel the English, and for the reasons you have stated?—Yes, and also because independently of the workmen being instructed, the manufacturer is enabled to get models of great beauty executed at a reasonable rate, which is one of the causes of the great abundance of beautiful designs in France.

575. Do you not consider that there exists on the part of the public in France an appreciation of lightness and finish in certain articles which the public in this country do not yet understand?—I am inclined to think that the opportunities which the French have of studying the arts must give a certain tone and feeling for them throughout the country; but I do not know that any superiority in that respect exists among the middle class of France as compared with the same class in England. With respect to the upper classes, I do not think the arts can be appreciated in any country more fully than they are in England.

576. Is there a species of silver work which is produced in Spain and Oriental countries called "Filagree work"?—Yes.

577. Is that produced in this country, or is it an object of very considerable sale?

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sale?—There are very good works in silver filagree executed in this country; as good as Spanish or American, but inferior to the Indian.

578. Does the difference of price induce any importation of silver filagree work?—There is no considerable importation of silver filagree work for sale.

579. Have you been in other countries besides France, and had an opportunity of observing the different education of the people in the arts?—I have been in several of the kingdoms of Germany.

580. Have you had an opportunity there of turning your attention to that subject?—Not as regards the instruction of artists, but as regards the manufactures.

581. What is the result of your observations, as to Germany, for instance?—They are inferior to the French in design, as inferior as we are, or more so, with the exception of the iron works at Berlin.

582. What remedial measures do you think are necessary for putting the English manufacturer on an equal footing with the French with respect to design and a knowledge of art?—The establishment of schools of design on a popular plan, which shall be entirely separate and distinct in constitution and management from any of the academies of painting and sculpture now existing in England; and in which it should be distinctly understood that the system of instruction to be pursued would not be intended to qualify the pupils for the professions of painting or sculpture, but merely to teach them the arts of designing and modelling with purity and taste, to be afterwards applied to any manufactures which they may themselves practise, or for the direction of the works of others.

583. In what way would such schools operate to improve the manufacturing artists?—In one mode by enabling young men to acquire a sufficient knowledge of the art of design, to qualify them for the double capacity of clerks and draftsmen or modellers in the counting-houses of manufacturers, who would thereby be enabled frequently to vary and improve the designs of their manufactures without much cost; the great expense of models and drawings by artists being one of the causes of the paucity of design in their patterns at present. I would observe here, that a parallel system obtains in the offices of architects and engineers, where young men are constantly employed in the capacity of clerks and draftsmen. Having gone through a certain probationary study, they are admitted as articled clerks until they acquire a thorough knowledge of their art, and after a certain time receive payment for their services. It would also enable apprentices in certain trades to acquire a knowledge of design, by agreement in their indentures to attend so many times per week at these schools, so that the study of the manipulation of their trades and the art of design might go hand-in-hand and bring both to perfection. I believe that this system is practised in France.

584. Have you been in the habit of visiting or attending the lectures of the schools of design or academies in this country?—I have not.

585. Then you cannot speak of their deficiencies so correctly as if you had attended the schools?—No; but I do not attribute any inefficiency to them, as far as regards the purpose for which they were instituted, that is, the cultivation of painting and sculpture in the higher walks of art; but I conceive that a deficiency exists in the want of public schools on a popular plan, for the purposes that I have stated, which at the same time might form elementary seminaries to qualify young artists for the academies already existing. The process by which a knowledge of the arts of painting and sculpture is now acquired is this: a young man receives tuition from a private master; he draws from the antique at the British Museum for a certain time, and when he shows that he has sufficient talent to qualify him for a student of the Royal Academy he is admitted; but the expense of acquiring that preliminary knowledge is considerable, and the young artist must also be maintained by his relatives during the time that he is acquiring it.

586. Do you think that much good would result to the manufacturing artists from the formation in different towns of museums and galleries of art to which they could freely resort at all times?—It would of course be indispensably necessary that every school should have connected with it a museum to assist the studies of the pupils.

587. Or, at all events, that there should be such a museum in the town in which the school is established?—Yes.

588. Do you think that open exhibitions of the finest works of all sorts in stone, paintings, bronze, and so on, would have a good effect in manufacturing artists, as giving specimens of the highest works of art?—Undoubtedly.

589. Then

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589. Then you think the formation of such institutions also very desirable with the same view?—Very desirable indeed; every school ought to have its museum, the expense of the formation of which would not be great, for casts from the antique statues, busts, vases, candelabra, gems, coins, and so on, would answer the purpose very well. Such a museum ought to be open to the public under certain limitations, to prevent their interfering with the studies of the scholars. There can be no doubt that it would be of the greatest benefit to the manufactures of this country by improving the taste of minor artists and workmen.

590. Have you ever turned your attention to the propriety of increasing the security of the copyright in models and designs of manufactures, so as to secure the privilege to the inventor for a certain period?—I have.

591. What do you feel to be defective in the present state of the law upon that subject?—The Acts of Parliament existing, as far as I know, on the subject of copyright in models or casts from models afford protection to a certain extent, but the objection is, that they do not go far enough.

592. Will you state, as a person conversant with the arts as applied to manufactures, in what respect you feel that the present law is defective?—In this respect, the protection afforded by the law to models or casts in bronze and other metals extends only to such designs as represent human figures, or figures of animals, or part or parts of such figures.

593. Will you state in what instances you principally find a want of protection?—I may state, for example, that however beautiful the design may be, if it be merely a model of *Arabesque* scrolls or foliage of any description introduced into any work, such as clocks, candelabra, &c., there is no protection for it; it may be pirated with impunity.

594. What protection does the artist enjoy in the case of designs which include human figures or the figures of animals?—He can recover, by an action at law, damages for any infringement of his copyright in that model.

595. How long does his copyright last?—In the first place, for a term of 14 years, and for a further term of 14 years in case he be still living at the expiration of the first term, and has not sold his copyright. That is the law at present under the Acts of the 38 George III. chapter 71, and the 54 George III. chapter 56. By the last Act the protection given by the 38 George III. to models of human figures or of animals, was extended to human figures clothed in drapery or otherwise, and combinations of the human figure with parts of the figures of animals, and also to any subject being matter of invention in sculpture. It is very difficult to ascertain the true construction to be put upon the words "being matter of invention in sculpture," but my opinion is that they would not extend to guarantee the copyright of any model of scroll work, &c. cast in metal. as in the instance of the iron gates of the royal entrance to Buckingham Palace at Hyde Park corner, which are remarkably beautiful. Now I apprehend that if casts or impressions were to be clandestinely taken from those gates, and another pair similar in all respects, but with the omission of the royal arms, were to be thereby made and sold, and the proprietors of the model were to bring an action for the piracy, it would be contended that there was no copyright in the design, as it would not consist of models of any part of the human figure or the figure of animals. Moreover, as it could be easily proved that the models of those gates were originally made in wax, clay or some plastic material, and then cast by the founder in iron, it would be held that there was no sculpture in the matter, and that therefore they could not come within the meaning of the words "matter of invention in sculpture."

596. In fact they are not protected under either of the predicaments mentioned in the Act, either as designs of the human figure or figures of animals, or as matter of invention or sculpture?—Certainly not, and therefore they might be imitated, provided the King's Arms, which of course contains representations of animals, were omitted.

597. Then the only protection afforded to the inventor of the design of those gates is the introduction of the animals in the King's Arms?—Yes, as far as regards the animals, but I conceive that even that does not protect the rest of the design; for if the Royal Arms were omitted, the protection would not extend to the gates, for no one could then say that the copies contained any figures of animals.

598. Does the imperfection of which you speak apply to the artist who invents the pattern in which the mould is made?—The imperfection applies to the proprietor of the model, whether he be the artist, or whether he has purchased it from the artist. By the copyright of a model is of course understood the exclusive

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privilege of making copies or casts from that model, which a manufacturer may purchase from the artist.

599. Do you consider that the inventor of models which come within the Acts of Parliament as representing human figures or figures of animals, is sufficiently protected by the present law?—I think he is.

600. Do you think that would be the opinion of such a designer himself?—I do.

601. Have you reason to believe from your conversation with such inventors of designs, that they consider themselves sufficiently protected?—I have, but the objection is that they can claim no protection for other designs.

602. Then would your suggestion for the amendment of the law in that respect, be to extend the same privilege to the inventors of designs in metal not including the human figure or figures of animals, as is now extended to designs which do include them?—Yes, that the protection should be extended to all original models whether representing any object in nature, or being mere fanciful designs.

603. Is an artist in France who makes fanciful *Arabesque* designs, as you have mentioned, more effectually protected than the artist in England?—I believe he is.

604. You have stated that in England the copyright is protected for 14 years, and at the end of that time for a second term of 14 years to the artist, if he be still living, and has not sold his copyright; do you not consider that too long a period with a view to afford the inventor a fair protection, and at the same time with a view to the interests of the public?—I think not, because articles of the nature of which I have been speaking do not sell rapidly; at first the manufacturer will sell but few, and it is only when they become known that he is repaid for his outlay.

605. Then, in fact, you consider that that protection is not too great, and that it should be extended to all models which do or do not contain human figures, or figures of animals?—Yes, I do.

606. Have you turned your attention, not only to the term of the duration of such copyrights, but to the best plan of recording new designs and models in England; for instance, by registration, by stamps, or by such other means as have often been suggested by different persons interested in the question?—I have. I would suggest that offices of registration or depositories of original designs should be established in the principal towns of the kingdom, where artists or proprietors of new models should deposit a correct drawing or copy of that model, accompanied with a declaration or affidavit of the artist or proprietor, that it is really a new model, and is his property. With respect to the stamps or marks on castings, taken from those models, the plan now adopted under the Act of Parliament is to stamp the name of the proprietor and the date in every such casting previously to publication for sale; but this mode is extremely inconvenient, and it would be a great disfigurement for small castings of figures, or otherwise, to have so large a stamp as would be required on them. It would, I think, answer the purpose better if to every drawing deposited a number were attached at the office; and that the manufacturer should be required to stamp his article with that number, and a letter which should stand for the name of the town in which it was registered, as A might be London; B, Manchester; C, Birmingham, and so on.

607. A kind of index, in fact?—Exactly; and by using the letters of the alphabet in the Roman, Italian and English characters, and those doubled by taking the capital and small letters, we should have 124 towns, many more than would be required for registration in the kingdom. In order to facilitate the understanding of these marks, it would be essential to the public that a key to the letters, that is, a list of towns and their distinguishing characters, should be exhibited in some public part of every office of registration. By that arrangement it would be easy to ascertain whether the models were really registered or not, which would be necessary to prevent persons from stamping their works without taking the trouble to register them, and from passing off copies of old models as new and original ones.

608. Do you know whether such a mode of registration exists with respect to any original designs upon the continent?—I have understood that such a mode of registration exists in France, by depositing drawings of models, but I believe the other part of the plan I have stated is new.

609. The numbering and the alphabetical key to the register is your own idea?—I

—It is; the intention of that is merely to do away with the disfigurement of small castings by so large a stamp as would be required for a name and date. Mr. *Robert Butt.* 7 August 1835.

610. Do you not think there would be a great difficulty in protecting the copyright of models in cases not of an exact copy, but of so near an imitation that one might sell as well as the other; for instance, a figure of Apollo, by altering the posture in the slightest degree, or putting a different drapery upon it?—I think a provision ought to be made to meet that.

611. With regard to designs in jewellery, does the observation you made as to the additional costliness of articles of silver extend also to jewellery?—It does.

612. Then in England our designs in jewellery are as good at least as the French designs?—They are superior.

613. Is that in consequence of the better price paid to the artist by the manufacturer?—I am not prepared to say that generally, for the manufacturer is frequently his own designer.

614. Then to what do you attribute the superiority of the English in designs of jewellery?—To the superior encouragement afforded in England to the manufacture of expensive articles in gold jewellery.

615. Does it apply as much to the design as to the execution of the articles?—It applies equally to both.

616. Then both the design and execution are superior in England?—Yes, in articles of gold jewellery, but in imitative jewellery they excel us, for there is greater encouragement in France for the inferior classes of ornaments than there is for the real.

617. In the inferior classes of French jewellery, are the designs better than in the inferior classes of English jewellery?—They are.

618. Therefore in this instance, as in the case of silver before mentioned, the arts extend lower down in society in France, and meet a lower class of consumers than they do in England?—Yes; the propriety of the distinction that I draw between the qualities of the real and imitative jewellery of the two countries may be inferred from the circumstance, that immense quantities of gilt jewellery are annually imported from France, and but little or none in gold.

Lunæ, 10° *die Augusti*, 1835.

WILLIAM EWART, ESQUIRE, IN THE CHAIR.

Mr. *Charles Harriott Smith*, called in; and Examined.

619. WHAT is your profession?—Sculptor of architectural ornaments. Mr. *C. H. Smith.* 10 August 1835.

620. Have you been long conversant with that branch of art?—I have been in it all my lifetime, and my father was in the same line.

621. When you say sculptor of ornamental architecture, you mean the interior decoration of houses?—More particularly the exterior in stone, and the interior in marble.

622. Describe it as accurately as you can?—Particularly such work as that about the exterior of the new National Gallery, on which I am now occupied; it is that particular department which I principally profess.

623. Do you mean the outside columns?—The capitals and other ornaments.

624. Architectural sculpture?—Yes.

625. Then in regard to the interior of houses, what do you do?—In a similar way; only that is generally in marble.

626. Cornices of rooms?—No, my business is more decidedly in stone and marble; small monuments for churches, ornamented chimney-pieces, &c.

627. Do you find difficulty in procuring useful assistants in your part of the profession?—No.

628. Statuary forms part of your business in churches?—Not figures or imagery, but monuments and ornaments connected with them.

629. Do you find any difficulty in procuring useful assistants?—No great difficulty, (of course there is a choice) provided I can afford to give them a fair remuneration.

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630. What are the ordinary wages of a clever person necessary for your assistance?—According to their abilities, about 2*l.* or 3*l.* per week.

631. You design yourself?—Yes, but I work a great deal under the direction of architects from their designs.

632. Are there any schools or studios where students can obtain instruction, or practise ornamental drawing?—No national schools; a few private academies.

633. The work of the operative is purely mechanical?—To a great extent.

634. But would it be desirable that they should be instructed?—Certainly.

635. It depends very much on dexterity of hand?—A great deal decidedly does.

636. How far do you think instruction is necessary to such artizans?—I have always found those who can draw, if ever so little, are more useful and have the preference. I was going to mention a case in point that recently occurred to me; I sent my foreman into Yorkshire with work; on his arrival he found difficulties arose which he had not, nor had I anticipated, and by letter to me, illustrated by his sketches, he explained all that I could wish for. No one but a man conversant with drawings could have done that; similar circumstances are likely to occur to any man in business.

637. And such men obtain in consequence higher wages?—Yes.

638. You think it very desirable they should obtain the means of instruction?—I think so.

639. What schools or studios are there for mechanics to obtain that instruction and practice in ornamental drawing?—There are a number of private seminaries for drawing and modelling ornaments, and such as is established at the Mechanics' Institute.

640. Are those schools tolerably furnished with the means of instruction for that particular object?—No, very insufficiently.

641. How is the Mechanics' Institute furnished?—I am not so well acquainted with it as to say if it is sufficiently.

642. Do you think it desirable, to give it a more national character, that there should be instruction in those branches of the arts?—Certainly.

643. Do you concur in the opinion of the other witnesses that public exhibitions would be very important auxiliaries?—I have always considered them the best plan that could readily be put in practice for diffusing taste; I have found often among workmen a desire of going to those exhibitions.

644. Among the workmen you employ do you trace any improvement?—Yes.

645. To what do you attribute that?—To good practice and emulation among themselves.

646. Do you include in that the opportunity of seeing works of art?—Yes, the opportunity of seeing works of art, and the opportunity of practising upon works that are likely to improve them.

647. Does the public demand for architectural ornaments increase?—I think it does, especially in my department.

648. Do you think you observe an improved taste in the public, as well as an improved capability on the part of the operative?—Yes, I think so.

649. In what branch of architectural ornaments are we most deficient in exactness?—We are most deficient in the true spirit of the Gothic or old English style of carving; but what is strictly called architectural ornaments are more particularly a mechanical process, such as Corinthian and other capitals, friezes of regular proportional parts, &c.; but where trophies, draperies and those sorts of things occur they become more decidedly connected with the fine arts.

650. Are the workmen less skilful in that branch than the mere execution of the mechanical part, such as the capitals of Corinthian columns?—Certainly, it approaches nearer to a work of fine art, and hence becomes more difficult to execute.

651. You find the want, in those instances you have mentioned, the effect of want of instruction?—Yes, certainly.

652. Do wages increase pretty much in the proportion in which the operative is removed from mechanical labour towards the production of art?—Decidedly, those branches that are purely mechanical and depend much on accuracy of measurement, such as the execution of Corinthian capitals, are done by ingenious

ingenious common workmen, if I may so term them; when they are employed on work nearly approaching to fine art, which requires more study and mental comprehension, of course the men have better practice, and if they succeed they demand higher wages, and are entitled to it.

653. Are the habits of the workmen in your branch of the art improved of late years, do you think?—Materially, decidedly.

654-5. To what do you attribute that?—I think much may be attributed to the change that has taken place of late years, by dividing those workmen who are fond of malt and spirituous liquors, from those who attend the coffee-houses and coffee-shops; the establishment of those shops seems to have separated the two classes, which has, in my establishment the effect, that the men who attend the coffee-shops seem to consider themselves belonging to a more respected class of society, and will not associate with those who go to public-houses.

656. Have you observed among workmen further removed from the mechanical departments, a greater disposition to read than those engaged in inferior work?—Decidedly.

657. Do you think the cheap penny publications have had any effect on their habits, and have been in any way instrumental in improving their minds?—I do think so; most of my men take them in.

658. Do not you think, that simply in consequence of the improved habits of artizans in your branch of art, it is desirable to give them further means of improvement, since their tendency is to a greater degree of refinement, and that they deserve encouragement by instruction, and opening public places of resort, where they will be made familiar with works of art?—Decidedly; I have heard them express a wish to that effect.

659. Both for instruction and the opportunity of inspection of works of art in the national Museum?—Yes.

660. Do you think if they were freely opened they would frequent them?—I think they would, and it would have a beneficial effect.

661. You think more would frequent them?—Yes.

662. Have you heard stated by your own workmen any impediments in the way of seeing works of art?—I have frequently heard them complain of that; and that the museums and exhibitions are not opened after their working hours, and that they have no opportunity of going to them, without not only having to pay for admission, but to lose their time, and of course it thus costs them much more than it does persons in easier circumstances.

663. Then do not you think it is of very great importance that those collections of works of art, whose influence upon the labouring population you think would be so beneficial, should be accessible to them at times when they could be visited without any great pecuniary sacrifice on their part?—I think it would be desirable; I have always considered that the best means of serving the industrious classes, is to increase their means of serving themselves.

664. Have you ever had occasion or opportunity of considering the state of the French nation as to ornamental designs?—I have visited most of the museums in France.

665. Do you think the French superior or inferior?—I do not think them superior in designing. The French are more aware of the importance of employing artists to design for their manufactures than the English are.

666. You do not consider them superior?—No.

667. May not that be attributed to the greater opulence of England, that there is a greater demand in England for architectural ornament?—No; I think that is not the case. What I have observed as to the comparative merits of the same description of works in the two countries, is this; I think ornaments are as well designed in England as in any country, but the French workmen, collectively, are better educated in art than the English workmen; consequently the French artist has a greater facility of getting his designs well executed than the English artist. The French people, as a body, seem not to be so satisfied with inferior performances as the English are.

668. You think there is more taste disseminated in that nation?—Yes.

669. Do you attribute this dissatisfaction with inferior art to any cause, to the education of the manufacturing people?—I think it is owing to the manufacturers themselves not being so well informed in those matters in this country as in France.

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670. Do you think the proprietors or conductors of manufactories in general sufficiently educated in the arts?—Whatever deficiency of taste is displayed in our manufactures, arises not so much from want of taste in artists to design and in our workmen to execute, as it does from want of study and education in the arts among proprietors and conductors of establishments wherein classical design and execution forms an important feature. I am also of opinion, that the public, as a body, are not yet sufficiently educated in the arts to discriminate between pure classical elegance and meretricious finery. I am alluding to the public as a body in this country; and the dealers' study is not so much to improve the taste of the public, as to discover what goods will sell most readily, and produce them the largest profit.

671. But the taste of the public must infallibly operate upon the seller?—Yes, decidedly.

672. A taste more refined would of course create a production more elevated?—Yes.

673. Therefore you think it not only essential to educate the manufacturing artist, but to a certain extent to educate the public?—Yes; I think the one will come with the other.

674. You would probably consider open exhibitions would be an excellent means of educating the public too?—Yes.

675. Do not you think the style of ecclesiastical architecture and the constant presence of beautifully ornamented churches have had a great effect in forming taste in the Catholic countries of Europe?—It would appear so decidedly.

676. Can you mention any particular instance of our manufacturers giving employment to artists?—Coade & Sealey, the artificial stone manufacturers, formerly employed some of our most eminent sculptors; among others, the elder Bacon, and Rossi; Rundle & Bridge, the silversmiths, used to employ Flaxman, Stothard, Theed and Baily, all of whom were eminent in the arts, to design and model for them. Wedgewood used to employ artists of eminence also. At the time they employed these artists they were doing an amazing portion of business. From what cause I do not say, but most of those establishments have changed their system of employing artists of eminence, and they have since employed inferior artists, of course at a much less expense. Whether that is the cause or not, I cannot undertake to say, but their business has certainly fallen off very much; they have now comparatively little or no business of any kind wherein the highest class of artists had been engaged, and the plan appeared to produce the most beneficial results to the proprietors.

677. Are works of art sufficiently protected by copyright, or would you suggest any improvement in the law on that subject, or the application of the law?—They are not sufficiently protected, especially those departments of art which are more immediately connected with our manufactures; I mean that which I profess. There is a constant piracy going on, and in my own practice I may allude to it more particularly. It is impossible to protect myself sufficiently from it. Any original drawings or models, whenever I am out of the way, are liable, by workmen or others, to be pirated, and I have no remedy beyond that of discharging an otherwise valuable workman.

678. Are you protected by any law at present?—Not that I am aware of.

679. You do not of course come under that law referred to at the last examination?—It never has been tried in court; I doubt if it might not come under that head, if it were tried; the copyright of the sculptor; the 38th and 54th of George the Third is understood in general not to include ornamental works of architecture.

680. Does the term "invention in sculpture" occur in the Act?—It does; and if a case were to be tried, it would very likely take in all classes of sculpture; but the chance of recovering is too doubtful and expensive.

681. It never has been tried?—I believe not.

682. You have not turned your mind sufficiently to the registration of inventions?—No, I think some plan of that sort is wanted, but I have not turned my mind to it.

George Foggo, Esq. Historical Painter, called in; and Examined.

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683. HAVE you turned your attention to the application of art to bronze and silver?—I have been repeatedly employed to design for them.

684. What

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684. What is the state of that manufacture now in England?—Exceedingly depressed.

685. Can you tell us why?—Principally, I should suppose, in consequence of the want of copyright, on which account the French have very greatly surpassed us.

686. What advantage have the French in the protection of copyright?—In England at the present moment the uncertainty of recovering in cases of a piracy, and the great expense attending a lawsuit, make it almost impossible for any but men of great capital to undertake such works at all. When they are undertaken, as the sale is exceedingly limited, those articles are almost universally converted into silver. In France, in consequence of the cheaper law and the greater facility of recovery, a much greater proportion of works of that nature are cast in bronze. So doubtful is the recovery and so great the expense attending it, that where otherwise 50 guineas would be expended on a design, not more than 5*l.* would now be ventured by the silversmith. As, for instance, in one case where the amount to be expended on a piece of plate was 800*l.*, I received 8 guineas for the design. In other cases, where the finished work would amount to 200 or 300 guineas, the utmost the silversmith could spend upon the design has been less than 5*l.* If the copyright could enable the undertaker of such works to spread them to the amount of 20 or 30 he could then afford ten times more on the design, employing none but the best artists, and rewarding them liberally.

687. The reason he does not extend the design to the number of 20 or 30 is because the design is pirated?—Exactly so.

688. What superior protection has the French artist?—I ascribe it to two points, the better definition of the law, and the cheapness of that law.

689. What is the duration of its protection in point of time in France?—I do not know.

690. You know the fact that he is better protected?—Yes.

691. Have you any further information to give the Committee as to the law of copyright in France, and how it is made available to the protection of works of art?—I still think that the main advantage of the copyright in France depends on the circumstance of the cheap law. I was lately in court in a case where the sale of spurious works was most clearly proved. The expenses, I was informed, amounted to 100*l.* and the award for the sale of five different and distinct prints was 15*l.* From what I recollect of such cases in Paris, I should say that the expense would have been under 15*l.*, and the award might have been 100*l.* It is therefore in France worth while (particularly when we consider the certainty of recovery) for a man of talent to claim his protection. It would not be so in London; bronze and silver are the same kind of manufacture, I should say: in most instances bronze is first cast for the sake of the silver plate; that was the case with the celebrated Achilles' shield, by Flaxman. The original shield in bronze, most elaborately and beautifully finished, could not have been sold for much less, if any thing less, than the silver-gilt. But the taste is so much in favour of the more costly metal, that no one would give 3,000 guineas for the bronze, when they could get the silver-gilt for 4,000 guineas, although the value of the silver be not above 250*l.*

692. Was not the article more valuable in one than the other?—I should say decidedly the bronze was most valuable, and I apprehend the taste of the public in that respect is deficient, inasmuch as gold and silver, having what I should term a positive colour, are less applicable to the works of art than bronze, and still more particularly marble.

693. But there is this distinction between silver and bronze, that bronze is more a work of casting?—In fine works it is afterwards wrought up with great nicety by the chiseller; in the above case Mr. Pitts, a very celebrated artist, was employed for that purpose.

694 *a.* Have you turned your attention to the mode of protecting inventions and designs in bronze?—I have.

694 *b.* Would you briefly mention such results of your observation and experience as you think worth describing?—I think, if it were worth the while of a man of talent to claim his protection, it would be best carried out, according to our habits, by special juries. Under the present system this is much too expensive.

695. Would you not propose that the jury to whom it was referred should determine, first, whether the person should have protection, and afterwards

determine the length of the protection?—I was only supposing a special jury in the case of a trial.

696*a*. What did you mean by a special jury; did you mean a jury of artists?—I would rather say a board of persons conversant with art, but subject like our juries to a challenge.

696*b*. Something like a *cour de prud' hommes*, or a board of competent arbitration?—I think so, but doubt whether it would be right for them all to be artists. I also think that the period of the duration of copyright should be in proportion to the talent displayed and the importance of the object. Some cases might not deserve three months' protection, others would require 50 years. Some things deserve also to be better protected than others, in consequence of the great facility of copying them. All works that can be cast in plaster particularly require protection; for that which has cost the labour of months or years and vast expense, may be re-produced by the plagiarist in a few hours. Such circumstances prevent the application of first-rate talent to any such productions.

697. You make the measure of protection depend on the talent of the artist?—In a great measure.

698. Should you not also consider that it would be for the interest of the public, for instance in a very beautiful work, that such a board or special jury as you have mentioned should have the power of proposing, on the part of the public, to the artist, that his design should be bought up?—I should have no objection to that, but I have a very strong objection to the consideration of the interest of the public being paramount. The circumstance of the Americans giving to their citizens an exclusive privilege of copyright, takes away all energy and exertion from those citizens. It has become scarcely worth while for an American to produce a work of talent, when the bookseller can get them from abroad for the price of a single copy.

699. Can you assign any other reason for the French superiority in designs in bronzes; do you think they are superior in the designs in silver?—I am of opinion the French are superior to us in the accuracy of execution of their work, but not equal in fancy and imagination; I have myself been employed to design for a work that has been sent over to France to be executed, and the execution was exceedingly correct.

700. You think the French understand the rules of drawing better than we do; their taste and their knowledge are more correct?—I should speak rather in favour of their execution and knowledge than their taste; for works in metal we still prefer that of the early period of Louis XIV. as more free and effective.

701. Was there some regard to cost when those things were sent to be executed?—I believe it was matter of consideration, but I must say that the execution was exceedingly correct.

702. Superior to what it would be in England?—By the same class of operatives: you might get three persons in this country to do better; but on the average you would find 10 in Paris to one in London.

703. To what do you attribute the superiority of the French in correctness of drawing?—To the various schools of design established in every principal town, but more particularly in Paris.

704. As to the schools in Paris, they are much superior to others?—The schools in Paris are so various, that I do not think that any but a resident in Paris can fully understand the difference; they consist of the Royal Academy and the government school of drawing; of private schools under an eminent artist, and of subscription academies, with no other than mutual instruction. Having resided 17 years in that capital, and studied in one of their best schools and at the Royal Academy for eight or nine years, I am decidedly of opinion that private schools, under the most eminent masters, are greatly superior to any public establishments. The private schools are the original system of the instruction in France, as they were in Italy during its greatness.

705. Are you speaking of the schools of the higher branches of art, or merely for the instruction of artizans?—These schools are generally intended for the higher branches of art; but persons who do not evince talent of a high order, naturally fall into the employment of manufacturers.

706. But are there not schools especially for the instruction of manufacturers, of artizans intended to be employed by the manufacturers of France?—There is one

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707. Is there only one in all France?—One for Paris; each department has something like a school of that kind; I am afraid it will be found they produce very little of that which may really be called talent.

708. Then in fact the French have no superior system of instruction to ourselves?—There is a national course of instruction very superior to the usual means in England; I mean those private schools.

709. This is national instruction and private schools?—It bears the most national character of any.

710. Explain it?—Every man of talent, as an artist in France, is supposed to owe much of his reputation to the pupils he produces; his object is to produce men of superior abilities, but the school gets popular and the system is so well understood, that the number of students becomes very great, and from their superiority they are, when interest does not interfere, appointed teachers in the government schools, and give a general tone to the talent of the country as far as circumstances admit.

711. Then the government schools, you say, are of no use?—They are very inferior to the others in utility.

712. How can those be called national schools if they are only private establishments?—They are not government schools, but they have the spirit of the country in them much more than the government schools, for the government schools are founded on one system, and, with one or two exceptions, all follow the same course; they do not fall into the wants of the times and the people so much as the private establishments.

713. How do you make out that those private establishments are national schools; if they are private establishments, they can hardly be called national schools?—I hope I have not made use of the term so as to bring it under the common English expression of national schools; I do not mean that they are in name national schools, but they are the schools that give a national character to the French artists; which character is materially checked by the control of Government administration.

714. Then there is no use in national schools in France?—In France Government interference in positive instruction is injurious.

715. Where is the encouragement given to art in France?—It is principally from the liberality of exhibitions, and most particularly of the libraries and the museums. The opportunities of study in the libraries and museums are far superior to any thing in this country. I may mention in proof thereof that the works of Flaxman, of Mr. Hope, and the publications on Etruscan vases of Sir William Hamilton were shut up in private collections in England, and produced little effect on the public taste; but being placed in the libraries in Paris and other towns, where not only artists but the public had free access, the knowledge and taste of Flaxman and Hope became there generally appreciated, instead of being, as in England, confined to a few. A fine example of their museums was that of the French monuments, where, in appropriate halls, samples of French statuary of seven successive centuries, afforded an excellent opportunity of studying the taste and the history of the nation. That of mechanical machines is also of great utility.

716. Then would you advise that there should be no instruction given to the manufacturing artist to that person who is to furnish designs for manufacturers, whether in tissues or metals, further than opening exhibitions in our towns generally?—Museums, I apprehend, must be the permanent and all-important sources of taste. Public lectures on the great principles of design and taste may be advantageously added thereto; and from the necessity of the case, another country being so greatly in advance of us in those branches, schools for the instruction of mere outline, and still more of the rules of perspective, would produce very great and beneficial effects.

717. Then you do think so much may be taught in schools, as regards what may be termed the positive and true in art, perspective, anatomy and those things, which, not concerning taste and imagination, are founded on unchangeable principles?—I certainly do think that much advantage would be derived from instruction in the proper simple rules, without shackling the taste; but it appears to me that good taste is so essential to the interests of the community, that museums should be provided at the national expense; but practical skill being an advantage of a more individual nature, ought rather to be paid for (moderately) by the individual,

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718. Is the public taste highest in England or France?—The general taste is decidedly highest in France.

719. You have also mentioned you consider superior taste and imagination more frequent in England?—I do.

720–1. How do you account for the distinction?—I think the arrangements of Louis the Fourteenth and Colbert have placed such fetters on imagination that the utmost that instruction can do in France is to inculcate fixed principles and precision of execution.

722–3. Was there not a very material change under Napoleon; did he not throw open the public taste more than what you have stated?—In the fourth year of the republic, under the Convention, schools of various kinds were instituted. Exhibitions and prizes were also decreed on a liberal scale, but they were ultimately counteracted by the re-establishment of the Academy, similar to Louis the Fourteenth's, and the occasional injudicious interference of the emperor. There has been no alteration in the academy of arts from 1800 till the present moment, except the exclusion of foreigners from the prizes, and a few minor bye-laws.

724. Do not you conceive that the fixed principles and correctness of execution are all that can be properly conveyed of instruction to an artist?—They are all that can be wished for when competition is encouraged.

725. And without free competition art is stifled, therefore it is essential?—Yes, absolutely essential. With regard to the departmental schools, if the appointments of professors were popular they might do a deal of good; but when I have seen an old man of 62 or 63 appointed to one of those schools, not for the good of his pupils, but to save him from starving, I cannot expect much good therefrom; when I have known in the principal school for the mechanics of Paris, a man of the highest talent, M. Peyron, after 25 or 30 years' exertions in the under professorship, superseded in his claim to the higher professorship by a friend of the minister, I find a total want of that principle, which free competition and proper elections would have carried out.

726. The reason you think superior taste and imagination more in England, is on acount of the restriction in France?—Yes, being under the minister of the interior, all follow one system and routine. In England, competition is created by commerce, which frequently brings a man from the humbler branches of manufacture to the highest stage of art, such as Martin, Muss, Bone, Bacon and Banks.

727. In fact the French attempt to teach that which is probably not within the strict limits of teaching, and interfere a great deal too much?—A great deal too much.

728. But still you admit the propriety of teaching the positive, the undeniable, fixed and positive rules of art, such, for instance, as perspective, anatomy, proportion and perhaps botany, and those things which connect arts with manufactures, in which the principles are undeniable?—I think it almost as necessary for a people to possess a knowledge of those points as to know how to write; I consider it a second way of reading all the beauties and merits of nature.

729. State the deficiencies both in England and France which exist?—First, the deficiency of correctness of perspective, even where correctness of outline is otherwise generally attained; perspective is often little understood in other countries, but is particularly neglected in England. Secondly, a very imperfect knowledge of the history of the arts and of commerce, their effects on each other and on the state of nations, and thence false theories.

730. What is the relative influence of the taste of Paris and London?—That the taste of Paris spreads all over France almost like lightning, while that of London is very much counteracted by the different habits and influences of our commercial towns; for this very reason, museums exactly similar might be established in France without any material injury; but museums in England would be best under the direction of a general board, but modified by the management of men capable of applying them to local purposes. If the town of Liverpool had a museum, it certainly would not, if left to the management of a local board, be similar to a museum in Birmingham or Sheffield, and it would be right that they should not be similar. A knowledge of mineralogy might be exceedingly useful in one town, and perfectly useless in another. Objects of general utility, of general taste, such as fine representations of the most beautiful pieces of sculpture; objects of taste, such as vases and ornamental designs in general, might

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might be exceedingly useful in them all, but each would superadd what was of local interest, in proportion to its connexion with different countries, and the manufactures on which it depended.

731. Would you combine any thing like a central system with a local system, particularly adapted to the character of the place, where the different institutions were established?—I think it most important that a local administration should be under a general control, or the control of a general board, in order to prevent local interests from holding too great an influence in the elections, and contracted views in the management; for I am greatly mistaken, if under a well-controlled representative system, the arts are not capable of disseminating knowledge in fifty ways that have never yet been attempted, and I am also strongly impressed with the notion that they should tend to a general improvement of the morals of the people as well as of their intellect. I have no doubt that under a proper general board with local management they would be highly capable of both.

Some of our manufactures far excel others in the merit of the designs, and this is usually in proportion to the difficulty of copying them, as the injury of a deficient copyright is therein less felt. I should instance, particularly, the japan manufacture, where the designs are more exquisite than anything produced abroad.

732. Do you attribute the excellence of design to the difficulty of copying?—Partly to that, inasmuch as it is an impediment to the plagiarist, and consequently a protection to the original designer.

733. You give the japan manufacture as an instance of that?—In consequence of the difficulty of the manual operation itself, the thing is better protected, and I ascribe it partly to the system of encouragement and competition established in the manufactures themselves; the works in japan are, however, conspicuously defective in perspective.

734. Do you mention this as an instance of the necessity of giving greater correctness of design to our manufacturing artists?—To show that of all the branches that ought to be taught, that of perspective is one of the first, inasmuch as it is not readily to be obtained.

735. Are there persons now employed in forming designs in japan as a business?—No, not mere designs; each manufacturer has his own designers and painters.

736. Is designing now a trade by which certain individuals get their livelihood, that is, to furnish patterns to the manufacturers of designs in paint?—I believe not, at least in Birmingham; what there may be in London I am not acquainted with.

737. You consider there is a deficiency in the production of designs from the circumstance of sufficient encouragement not being given to the instruction of persons in designing?—I consider in that particular line the designs are very superior, but there are inaccuracies from want of instruction.

738. Have you ever had an opportunity of comparing the japan of this country with the French?—At some interval of time and distance I examined them repeatedly, but not lately; there are no French ones that can at all compare with ours.

739. Which have the superiority?—Ours as far as possible; the French would shun the competition, though many individuals in France are anxious to introduce our japan articles into France at present.

740. Do you consider the japan better, or is it for the sake of the design?—I consider we have the advantage in both ways; we are not equal in execution to the Asiatics, but superior in design.

741. Have you had an opportunity of knowing the mechanics' institutions?—I have.

742. Would you consider the mechanics institutions the best medium through which to establish this mode of instruction, with a better code of laws, if their political feelings would permit?—Political and religious discussions are generally excluded by the laws of mechanics' institutes; but there is a strong aversion in the leading institutions to the Government having any thing to do with them.

743. Our friendly societies are regulated by an Act of Parliament; if some Act of Parliament regulated the mechanics' institutions, giving them correspondence with one in London, and an interchange of models and designs,

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would that be a very good course?—I am afraid sufficient attention has not been paid to the history of our benefit societies. I have not a doubt if those societies had existed without the late poor laws in England, they would have been so alike, so perfect in their management, and so generally in use, that you could at once apply any thing by their means.

744. These mechanics' institutions would be so far more beneficial than any school of design, that they would convey to pupils knowledge in chemistry or mechanics or design, according to their natural genius; would that be better than restricting a school to one pursuit?—They would do exceedingly well if you could manage the election of the professors; but in that case a member of an institution is more likely to be elected than one not a member; it is therefore local talent which gets the influence, which is not so good as a person confirmed by the approbation of a general board.

745. The professors of those institutions might be subjected to the decision of a board in London, might they not?—If the institutions would agree to that, much good might be effected.

746. The advantage mechanics' institutions would derive from the parent institution is, they would collect a variety of models, which they cannot now obtain?—Certainly.

747. Therefore in this country where you have three or four branches of trade carried on, in Manchester, and in some places almost every branch of trade, you would not confine it to a school of design only, but make it one branch of what would be a drawing class; those who have a taste for chemistry would be good preparers for the materials of printing, and so you would make it useful?—Yes. Another way might also be easily accomplished, by placing museums under the direction of men capable of communicating instruction.

Samuel Wiley, called in; and Examined.

Samuel Wiley.

748. WHAT firm do you belong to?—Jennings & Betteridge, of Birmingham.

749. Do you pursue the japanning trade?—Yes.

750. Have there been great improvements in that trade of late years?—Yes.

751. To what do you attribute it?—To the energies of Jennings & Betteridge; being men of taste, and stimulating their apprentices and teaching them the art of drawing; they have taken great pains.

752. You attribute the extension of their manufacture to that instruction?—Yes.

753. Do you think further instruction is requisite?—I do; I think it is essential to form part of the education; the art of drawing, whether they are to be japanners or any other art or trade, it is, I think, a great assistant.

754. In what particular branches of execution do you think they are deficient now?—In perspective.

755. In any other besides?—Generally in outline.

756. Do you know whether the workmen themselves, if they could obtain public instruction, would feel it a benefit to their manufacturers and themselves?—I believe they would prize it much.

757. Are the habits of such men now such as would induce you to suppose they would more highly value this instruction than many years ago?—I think they would.

758. Their habits are improved?—Yes.

759. Have you had an opportunity of seeing that, so as to say if the exhibition of the works of art would be of use?—I think it would.

760. They would attend?—Yes.

761. And take an interest in them?—Yes.

762. Have you heard them express an opinion of that kind?—Yes, frequently; our men have inserted works of art in the Birmingham Exhibition and other places.

763. Some of your artizans have contributed to exhibitions?—Yes.

764. Are there any other deficiencies which you would wish to notice in the present works of the japanners in which they want instruction?—No, I think that embraces all that is essential.

765. Can you make any other suggestion which would increase your trade and encourage artists?—By improving the public taste; the public taste is bad; I could

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I could sell them the worst things, the most unmeaning, in preference to the most splendid designs and the best executions.

766. To what do you attribute this defect in the public taste, and how would you remedy it?—I do not know by any other means than by the rising youth being taught the art of drawing and perspective.

767. Do you mean the rising youth in our manufacturing towns?—Yes.

768. Those who devote themselves to manufacturers?—Yes; and public exhibitions would lead the public to view for themselves, and they would begin to form a taste in those things.

769. Is this the result of your observations in Birmingham?—I could frequently sell bad articles, bad in execution and design, for the same money as I could sell the best.

770. You think that the means you suggest would increase the public taste?—I do not know what else would; it would excite them to a spirit of inquiry.

771. Has the public taste improved?—I think it has.

772. And you think, as better things are submitted to them, the public taste will be improved?—Yes; it will gradually supersede those awkward unmeaning designs which they have generally been accommodated with.

773. Do you imitate the Chinese patterns?—No.

774. Do they imitate ours?—No, they adhere to but one style of work exclusively, and that most beautiful in point of execution, but unmeaning as it regards design and perspective; in fact, the designs are very bad.

775. Is there any information you wish to give respecting the Chinese?—The materials they use I consider one great means of their goods looking so much better than ours; the material they use. Their material after it is laid on, whether it is gold or gold powder, is never varnished, and there is a degree of brilliancy and richness that never appears after it is varnished; we are obliged to varnish ours to preserve its colours, in doing which we lose a great part of its brilliancy. Some years ago we procured gold powder from China, and could make it appear of the same appearance as that from Canton, and we found it very valuable indeed for the purpose of imitating the Indian cabinets and the various articles we have to copy or to repair; but there is a different appearance, as different as possibly can be, between the Indian gold and gold powder, and that of British manufacture; and the material they use for laying on the gold is different; we are informed it is a gum extracted from trees, and when the parts are laid on they are the very same as though you cut small gold wires and laid them in, there is that prominence.

776. It is more in relief?—Yes.

777. There is no impediment in procuring gold powder?—There is no trade in it; we only got it from one person.

778. You could get it by sending to China?—It was accidentally we met with a party who had been an Indian merchant.

779. Is it so dear?—No, we found it much cheaper than ours; Mr. Jennings was about making a journey to Canton to procure some himself.

780. Is it generally used, that gold powder?—No, we cannot procure it.

781. The Chinese prohibit the exportation of it from China, do they not?—I believe so.

782. Or is the importation prohibited here?—I do not know; we have applied to various merchants for it; whether it is an article that never comes under their observation we do not know.

783. Have you had it analysed?—No.

784. Could you not try the quality of it by taking some off a piece of workmanship in their trade?—No; we have endeavoured to procure more.

785. Did you not analyse it then?—No.

786. You are not aware whether the difference arose from a combination of gold with other metals?—I think it is prepared by a chemical process, and I think also that it is from the compound that it is better; very likely the metal with which they mix their gold is of a finer quality than ours.

787. The Chinese have a great advantage in their gums?—Yes.

788. Has the japan trade very much extended of late years?—It has.

789. Have our exports of japan articles increased?—Generally gums, except to France, and there we send the best we make.

790. Do you send much to the United States?—It is generally very common.

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791. To what countries have they increased lately?—Principally for home consumption.

792. Do you pay the persons who paint the articles by the piece generally?—Yes, and some of them, the best of them, by the week.

793. How much do they earn by the week?—We pay from 15*s.* to two guineas; in some few exceptions we pay from three to four guineas and a half; one we pay four guineas and a half; the only one.

794. Are persons in your trade employed exclusively in drawing patterns?—No, some excel more in designing than others, the working men; every workman designs his own pattern.

795. Is a good designer well encouraged?—He is the most valuable man.

796. By the manufacturer?—Yes, he is the most valuable man he has.

797. Is there any want of talent among designers, provided it were sufficiently developed?—There is a want not of talent but of facilities; good things to copy.

798. State why you think the French prefer our articles?—They are much better.

799. It is the quality of the material, not the workmanship?—Both material and workmanship are better.

800. And the design too?—Yes.

801. Your designs are superior?—Yes, superior to the French in the japan trade, in characters and the beauty, and every thing.

802. You state we are defective in outline and perspective; have the French the same defects?—They do not seem to raise the japan trade to an art; they appear merely to daub it over and call it japan; there is neither design nor beauty of execution.

803. Is it necessary for a person who designs, to be acquainted with the manufacturing branch of the business?—Yes, it is indispensable.

804. Would it not be necessary the artist should be instructed on the spot?—No, I think not.

805. If it be necessary to combine the designing and manufacturing, it would be necessary to have a school to teach them on the spot, would it not?—No, we generally come at 12 or 14 years of age; if they have previously been taught drawing with perspective, it is a sort of tuition in the other branches; drawing and perspective are essential for them to be taught this afterwards.

806. You teach them first of all drawing and designing, and then manufacturing?—Yes.

807. You think the first branch may be learned in London or elsewhere, and the rest in Birmingham?—Yes.

Veneris, 14° die Augusti, 1835.

WILLIAM EWART, ESQUIRE, IN THE CHAIR.

M. *Claude Guillotte,* called in; and Examined.

M. C. Guillotte.

14 August 1835.

808. YOU are a maker of jacquard looms?—I am a maker of jacquard looms, and of all sorts of looms for silk manufacture, and of French bar looms, by Premaillerre, upon which (the bar looms) from ten to thirty ribands at a time may be manufactured, and the whole of the machinery conducted by a young man. Of those, I manufactured 150, at several times, and for several parties; and they were the very first ever introduced to this country, and for which machinery I took out a patent.

809. Do you make them for cotton?—No, I make none.

810. Does not jacquard machinery adapt itself to all sorts of tissue?—Yes, I made three years ago the most complicated machines ever produced in England, with 4,600 threads, at a cost of 50*l.*, and before it was put in order and set to use, it cost 100*l.*; it was for weaving napkins and table-cloths, which was all worked by one man. I also made many of the jacquard machines, with 1,600 to 1,700 threads, for smaller table linen. Of late, I am making jacquard machines by hundreds,

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dreds, for all parts of England, where it had not been introduced before. For Yorkshire, I am particularly engaged at present making them for merinos and damasks, and the same for Bolton and Manchester; I have agents in Manchester, and Bolton district; and I have been engaged in making them at Coventry for riband.

811. Can you give the Committee any information as to the number of jacquard machines in operation in this country?—From 7,000 to 8,000 jacquard looms.

812. Has there been of late any great augmentation of the demand?—There has been an extraordinary increase; for the silk manufacture, I received in London orders for 6, 8, 10, at a time; in Yorkshire, I receive orders for from 60 to 80 at a time; and for worsted manufactures, the demand is also considerable. The demand commenced about 11 years ago, and has become much more active of late in Yorkshire; and yet, I was four years ago in Yorkshire, at Halifax, Huddersfield, and the surrounding country, with an interpreter, taking with me half a dozen, and there was no individual willing to purchase one; and after my return, I received an order for one machine, in order to make an experiment; it succeeded, and the consequence was, an order from the same individual, a Mr. Gill, to manufacture more than a 100 such machines, and there was a demand at any price from every body. These were to replace the old mechanism, which was employed in producing small patterns; those are principally used for waistcoats.

813. Does the demand increase?—The demand could not continue so great as it was; it was very great. There is still a demand, but principally for merinos and damasks. In Scotland I have an agent, but I do not do much, the price of the cards for the manufacture of Scotch shawls being too high. The difficulty of applying these cards to shawl-making is, that for the production of the beautiful pattern, 5,000 or 6,000 are required, which makes it too expensive a machinery. At Norwich, a good many were sold one or two years ago, but they are expensive, and it has prevented its being much applied to the silk manufacture. In Scotland, they use a draw-boy instead of a jacquard to make the figure, to draw the threads that produce the figure on the cloth; in Scotland and Norwich, the number of cards which are necessary for the production of a figure make the employment of jacquard machines much more expensive.

814. What are the average wages they obtain in the manufacture of your machines in London?—Sometimes I employ foreign workmen, but they leave me when they can better their condition; and a good workman, such as I can employ, will get thirty shillings a week.

815. Is the price greater in England or in France?—I think the price is cheaper here than it is in France, and I account for it thus: Because I carry on the whole of the manufacture in my own workshops; while in France the production of a jacquard machine is divided among the workshops of several persons.

816. Is there the same competition in England as in France?—There are only two principal makers here, but the competition between those two is so great that the prices are kept low.

817. Some have failed who make them?—Many inexperienced persons have made attempts, but have not been able to compete with those who had more experience, and they have failed in producing the article as cheaply as we. I employ about from thirty-eight to forty workmen, all in London.

818. Is your trade confined to manufacturing machines, or do you give instruction as to the pattern and reading and stamping the cards?—I have a clerk who undertakes this latter department, and in my own house I give instruction on the subject.

819. Will you explain what takes place in the adaptation of the design to the loom?—First, the design or pattern to be made on the cloth is drawn on paper and produced for approbation; it exhibits on paper what it is intended to be on the cloth; as the threads are very minute, they are then as it were extended on another paper, the rule-paper, of a larger size, which shows the pattern as it were magnified, so as to place so many threads to the inch, perhaps 20, so that every square represents a thread. This is what the French call *mise en carte*, and in English put upon rule-paper. The next process the rule-paper undergoes is, to be read in, which transfers the pattern from the rule-paper, and prepares it fully for the stamping of the cards. The rest of the process is mechanical, consisting of punching holes in the cards, according to the number required, and applying the card to the machine. In this mechanical operation I have seen 200 boys employed in weaving the richest figures in the loom. To so simple a principle is the process of weaving now reduced,

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reduced, that even boys of 16 are set to weave the figures of so complicated a nature, as formerly would have required men of 20 or 30 years' experience.

820. In this process what is the difference between the French and English manufacture?—In some departments the manufacture is superior in England; in others in France. Plain silks, if manufactured with the same materials, the production will be equal in England as in France; figured silks are equal, as respects the mere manufacture; and there are two points of inferiority, the designing and the *mise en carte*, put in rule-paper.

821. Have you observed any particular reasons for inferiority in England?—One cause which has much struck me is, the very costly price of cards. In the woollen manufacture the cards which have been used for woollen goods have, as I have observed, been returned to the Excise. A return of duty has been obtained. I think that if the same thing were done with the jacquard cards, it would have a tendency to diminish the price. Though generally speaking the price is about equal in the two countries; yet in the reading the designs there is this enormous difference; the average price in France is three francs, or half-a-crown sterling; in England, the price was a long time 15*s.*; it came down to 10*s.*, and I now charge 8*s.* per hundred. I attribute that to two causes, the presence of silk-manufacturers, which has created a greater competition and a greater necessity for activity.

822. This activity commenced in 1823?—Yes; but since 1826 the activity and competition were very greatly increased. The consequence of this competition has been also the introduction of a great many French dyers to settle here. The French designer understands the *mise en carte* (putting on rule-paper) better than the English designer; and the French *metteur en carte*, understands design better than the English *metteur en carte*. The great reason that occasions this great difference between the *metteurs en cartes* and designers of England and France is, that the designers themselves are obliged to put it on the rule-paper, and previous to that go through every branch of the business, (including the weaving), and this is undoubtedly the cause that they are more perfect.

823. Do they design better in France than here?—I do not mean to say that; but there is a much greater number of designers of the same capabilities in France than here. In consequence of the encouragement the French designers receive, they are as well more numerous as more talented in their science, in common; although there are individuals in England equally as clever, and with a profound knowledge of their art.

824. Is the designer and the *metteur en carte* the same person?—The artist who draws the designs at Lyons is the artist generally employed to transfer it to the lined paper. This person, whom I consider the *metteur en carte*, is only employed in that; he is inferior here. In Lyons, in a great number of instances, there is never a design drawn at all; but the first production of the design is on the lined paper. The *metteur en carte* is himself an artist. It is in the connexion between the arts and the manufactures that we are inferior. In France a manufacturer employs from three to four artists, and in England one artist supplies eight to ten manufacturers.

825. What is the difference in the wages of an English and a French artist employed in painting the patterns on the ruled paper?—I have long endeavoured to obtain such an artist from France, and I think if I could obtain such a one as I desire, it would answer my purpose. An indifferent artist of this sort may be obtained for 50*l.* a year, but there are men whose services are worth from 400*l.* a year, or even a share of the manufacture. The sale of the fancy trade entirely depends upon the taste and abilities of the designer. In France there are often only one or two artists who are paid, and largely paid, who get from 180*l.* to 200*l.* a year, but there are several who give their services for the instruction they receive. The *metteur en carte* ought to be well instructed in designing. He ought to be also well acquainted with manufactures in theory and in principle. They are so at Lyons, but they are not so in this country.

826. When was the jacquard loom first adopted at Lyons?—After the Revolution. Before the invention of the jacquard machine, eight or ten years were required to make a good workman; afterwards six months were sufficient. For 10 years after the discovery, the machinery remained with very little influence, but designers increased with the introduction of the machine.

827. Was the secret of the jacquard machine long kept in Lyons?—It was kept, and it was not kept; the machine was not originally of great value.

828. At

828. At what time did it come into activity at Lyons?—From 1808 to 1810 the machine was brought into activity, but at that period it was very imperfect. In 1814 it was much improved, and in 1815 it was fairly established.

829. Did not the French manufactures materially improve by the jacquard loom, and gain great advantage by it before other nations?—When France possessed the monopoly of the jacquard machine it gave her great advantage in other countries; but since it has been introduced into many other countries; France has only by great exertions produced better and cheaper than they.

830. Is there a school of design at Lyons?—Yes.

831. In consequence of the discovery of the jacquard, have there been any changes in the school of design at Lyons?—The young artists have since the discovery particularly turned their attention to the *mise en carte*. There has been every augmentation of such young artists; indeed there were no such artists before; for it was found requisite to set up jacquard machines in the school of design. This lasted two or three years only, as they now obtain the required knowledge of the loom out of the school. The discovery of the jacquard loom infinitely multiplied the number of young artists, who devoted themselves to the *mise en carte*. The great advantage of jacquard machinery is this, that it enables that to be done in a few weeks, which before occupied months; and that the change of a pattern formerly was a long, laborious and costly affair, and now it is a very simple one, and may be done in a few minutes after the completion of the reading and the stamping of the cards.

832. What do you consider the best means of instruction for the purposes to which you have been referring?—In France, in ordinary cases, our artists receive six months' instruction in the theory of the manufacture before they are called into the field of practice, after they have been instructed in the school of design at Lyons; or artists, during their instruction, must pass two hours a day to understand the theory of the application of the design relative to the machine.

833. Are there not instructors in Lyons who give private lessons to artists, particularly with respect to the *mise en carte*?—There are private instructors who give those lessons in the school of design at Lyons; they also give instructions in the *mis en carte*, making their talent practical.

834. How many jacquard machines are there in this country?—From 7,000 to 8,000.

835. Are the English in the habit of copying the French designs?—The English copy the good French, and the French copy the good English.

836. What are the best English designs?—The best are those in cotton goods.

837. Can the designers for the cotton trade in England design equally well for the jacquard machine?—They do not understand the *mis en carte*.

838. Where do the English obtain such knowledge, enabling them to make good patterns in cotton?—The English designers, who make these good designs in cotton, are instructed at Manchester, and elsewhere, but the number is not great; for the drawing of silks, Mr. Adams and Mr. Perrin are good, and there are four or five inferior.

839. You sometimes make good copies from English patterns for the Spitalfields looms?—Yes, many from the English printed muslins, but it requires taste and knowledge to arrange them.

840. The French manufacturer can come with patterns every year to England, bringing with him patterns on the material; not only designs on paper, but on the material; whilst the English manufacturer only brings it on the paper?—Yes; the cause of that is, the French manufacturer employs weavers who are solely engaged in the production of patterns, and as the pattern on the tissue cloth shows more distinctly the effect than the drawing on paper, it gives them an advantage in the market.

841. Do you know any one who collects English patterns, takes them to the continent, and brings the continental patterns to England?—There are individuals who are engaged, and who collect at Paris the patterns in vogue there, which they bring and dispose of in England, and they also carry to the continent such patterns as they can collect here for the purpose of sale. These only serve as mere ideas; in the execution of the working drawings the French improve upon us.

842. If there were a school of design established in London, what do you think would be its influence on English manufactures?—My opinion is, its effects in three

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three years would be so to equalize the manufactures of the two countries, so that the country in which they were produced would not be recognizable.

843. Is the jacquard machinery applied to other raw materials besides silk?—It is applicable to every thing which is figured or flowered, every thing that can be woven. The jacquard is applicable to every species of tissue to which a loom can be applied, even to straw hats, horse-hair and wire, and every other species of web.

844. What are the principal difficulties in the way of improvement in the silk manufacture?—The first is the high duty on paper. The high price of paper has this injurious effect, that the manufacturer is very unwilling to change his patterns. There is a difference between the cost in France and England; it is as one to four.

845. Is the English card here inferior to the French?—The English is superior, but that makes little difference, because it is never worn out, a new pattern being always introduced before the cards are worn. The two disadvantages I consider are these, the higher price of the cards, and the inferiority of the *metteur en carte*.

846. Do you attribute the difference to the Excise duty on paper in England?—Much of that difference I attribute to those causes. Much of the difference I attribute to the Excise duties; but I consider the great impediment the inferiority of the English artist in the *mise en carte*.

847. Have you an opportunity of knowing whether the English manufacturers recognize their inferiority, and would be willing to do what depended on them for its removal?—I have had frequent opportunities of conversing with them on the subject, and I think, when they see the difference it produces in the work, they would do so after some time.

848. What is the difference as to the dyeing, if your attention has been called to that subject?—I think, in a great many cases, where there is an apparently greater beauty in the French dyes, they are much less permanent than those of England, and I have seen many examples where, after a few weeks' wearing, the French colours have wholly faded.

Gentlemen,

HAVING answered thus to the best of my knowledge your questions, I take the liberty of making the following few remarks about designing and *mise en carte*; for as this is the very head part of all that belongs to the weaving department, and at the same time is the very least cultivated in this country, it is before any thing else the most worthy of your attention and consideration. For as long as this part of the manufactory is not highly improved, and proper schools for design and *mise en carte* erected, and children, who already have acquired the practical and theoretical part of weaving, are engaged and trained up in this art, France will always have to boast over England of the honour of sending more fancy patterns, and finer and more beautiful workmanship, and, in fact, brought to the highest perfection. But, on the contrary, if it should meet with your Honourable Committee's approbation, and get the least encouragement to bring it into fulfilment, and to get such schools erected in some quarter of Spitalfields, or its arrondissement, there is no doubt whatever in a very short time the English manufactures will soon rival, if not altogether equal, the French manufacture, and thus throw off the shame of seeing foreign manufacture surpass the English in quality and superior workmanship.

Your very humble Servant,

Claude Guillotte.

Lunæ, 17° *die Augusti*, 1835.

WILLIAM EWART, ESQUIRE, IN THE CHAIR.

Mr. *John Henning*, called in; and Examined.

Mr. *John Henning*. 17 August 1835.

849. HAVE you been in the habit of executing works in relief for a considerable time?—Yes.

850. You executed the frieze on the entrance over the gate-way at Hyde Park Corner, and the frieze on the Athenæum?—Yes, in conjunction with my son John, who had contracted with Mr. Burton to do that work in 1827, which was followed by the frieze of the Athenæum, which was a selection from the sculptures of the Parthenon. On both friezes the design was drawn upon the stone and cut without the usual process of pointing. These were our first works of the kind in stone. Previously I had been engaged principally in drawing and modelling, and our first work

work in intaglio was the sculptures of the Parthenon, which was begun in 1816, and finished in 1822.

851. Have you ever had occasion to consider the subject of copyright?—Yes, I have, but I have only to tell the Committee of the difficulties which we modellers and sculptors experience; I do not feel that I dare presume to propose a remedy, though I may notice the evils which I have suffered.

852. State them as clearly as you can?—I have brought a specimen of the frieze of the Parthenon engraved on slate in intaglio; I have also brought a cast of this intaglio in plaster, and another, broken, in the way in which it appears now in the Museum; the intaglio is the matrix from which these casts have been taken; previous to engraving the intaglios, careful drawings were made from the mutilated marbles, and the deficiencies were made good to see the effect, and then they were transferred to the slate in the opposite direction, that they might be right when cast.

853. You were going to state the difficulties which these specimens were to elucidate?—Yes, as soon as the casts are issued, whoever lays their hands on them may, with very little trouble, take moulds in sulphur, wax or plaster, and multiply them to any number.

854. You consider that the law does not afford you protection?—There is no protection, as I understand, but in an action at law. The thing appeared so unmerciful to me, to lay hold of a poor man to raise an action against him, that I never could think of doing that. It struck me that if there was anything like a committee of art in London that could be appealed to, to identify where a spoliation or theft of this kind had taken place, it might be much cheaper than law.

855. A species of arbitration committee?—Yes, for any gentleman who knew anything about it, could detect those thefts readily.

856. Have you ever thought of the subject of registering such works?—I always have understood by the law, that if you put your name and date it was sufficient, but I think such property as much my own as my clothing, and no one has any more right to appropriate it, than to claim my personal labour without remuneration. The originals exist in the Museum, open to all who may desire to make studies from them, without condition, but compliance with the economical arrangements of that institution. This would be fair and honourable strife, who could do best; but what hand or heart can contend with the covetous and unjust, who, by the cunning labour of a few days can contrive to rob me of years of life, and scatter over the whole land the deteriorated casts of my works, much to my prejudice as an artist?

857. All you want is a cheap tribunal?—That is the very thing wanted.

858. Have you suffered from your own works being infringed upon?—Yes, very much indeed.

859. Can you give any remarkable instance?—I had, within the last six months; a man, without giving me his address, wrote to me twice, and put me to the trouble of writing to him; at last I got a third letter, giving particular orders to make them ready. I took it to be some gentleman; at last I found after I had packed them up by a given day, I found he had gone to a person who was in the habit of furnishing people with them, and he never came near me. Nothing would do in that case but an action at law, therefore I preferred rather putting up with the loss.

860. You submitted silently to the inconvenience rather than encounter another?—I cannot blame anybody for that but myself.

861. Then he pirated your works in this case?—No, I could not call this piracy, but rather resetting, for he went to the pirate who served him with my stolen goods; but many have pirated them, and continue to do so.

862. You felt you could only have recourse to an action at law?—I never understood that I had any other recourse than that.

863. Why had you not?—Because of the expense, and I could not think in my heart of prosecuting a person, probably without a shirt, who perhaps did it from poverty; I could not proceed against him.

864. You are a self-taught artist?—I do not know what to answer to this question; however I have not had any thing like what might be called regular instruction in art. In art, as in every profession, the master, in many cases, can only be considered as the finger-post which points the road the pupil must go on to the place; the pilgrim, creeping or running, must exert himself to the end of his journey, otherwise he will never arrive there.

Mr. *John Henning.*

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865. Do you think instruction in the arts generally, in a national point of view, is advisable for persons acquainted with the manufactures of this country?—I think, in the present state of society, as there are so many means for individuals to be instructed, that I do not see that the interference of the Government would do much good. The one great good that an academy or school with a good museum would be, to give facility to study to the willing, who are often prevented from advancing in their pursuits by the difficulty of access to proper models. I would propose a voluntary subscription museum, conducted by a committee of the subscribers, in places where these were to be found, furnished with models of every description, particularly all mechanism of every department of manufactures, every kind of fabric of cloth, plain and ornamented, or coloured, and if possible the mechanism by which it has been done. A museum of this kind, with proper regulations, under the care of a person or persons qualified to make it useful, under the control of a committee, would be of much use in promoting skill in art and science in design, whether it were the highest branch of art or the more common, where the artizan plans to combine beautiful forms with various colours in fabrics of cloth; in short, in every profession it would be of use that the operator should be able to draw any thing which may occur in his profession; the surgeon, by drawing and modelling, would acquire a more correct notion of the position of the localities of the veins, arteries, &c., of the human body, and so with every art. Drawing and modelling give great power of description. I think society ought not to trouble the Government with things which it can so easily do itself; and done in this way, I think that it would have the best effect; while it would be a proper stimulus for the improvement of talent, it might bring to light the more rare and superior minds, and lead to the existence of a general true taste in the decorative arts. The carpenter would study what related to architecture; the geometrical construction of roofs, centers for bridge-building, &c.: the cabinet-maker would be engaged also in straight-line drawing, construction and the ornamental parts of his art.

866. The question referred to art rather than manufacture?—Every man who follows any profession should have something of drawing relating to his profession; and a workman, such as a jeweller, ought to be a draftsman, for he in fact does not work by the square and the compass, but by the eye; therefore he should be taught drawing.

867. You think the principles of drawing should be united in some way with elementary education?—Yes, with every profession, and the weaver as much as any; most of the weavers of my native place, Paisley, used to draw their own patterns, and many of them could do their own machinery. The drawings in many cases done by themselves were transferred to the cloth by what they called "reading it on the holly brod," which seems to me to correspond with the *mis en carte* of the French. At that time (40 years ago) many could mount their own webs; now from the division of labour this has become a separate business.

868. How did you obtain the original casts from the Elgin marble, from which you made these smaller casts?—When I arrived in London in 1811, through the introduction of Mr. Murray, brother of the Lord Advocate, I was introduced to Lord Elgin, who gave me permission to draw from the marbles. He told me it was requisite for a member of the Academy to give a recommendation. His Lordship entered my lodgings one morning with a gentleman of the Academy, who after examining some of my drawings, medallions, busts, &c. spoke in very complimentary language of them. Lord Elgin said that I was desirous of being allowed to draw from the marbles; the gentleman answered in great earnestness, "To allow Mr. Henning to draw from the marbles would be like sending a boy to the university before he had learned his letters;" a few minutes after, they left me a little surprised. However, within a quarter of an hour his Lordship returned, and told me that I might begin to draw whenever I thought proper. Such was the origin of my studies from the Greek marbles. They were not in the British Museum then, but in a temporary building at Burlington House, Piccadilly. He gave me permission to draw, with this proviso, that I was not to make any publication without his permission, which I very willingly assented to. They were afterwards moved to the Museum, and I got permission of the Museum to continue my drawings there.

869. From whom?—The officer of the Museum, Sir Henry Ellis; he was then Mr. Ellis.

870. Did you at that time take any moulds?—No; for I still felt that with regard to Lord Elgin, I had no liberty to make any publication without his permission. Then, on their being introduced at the Museum, I asked my friend, Mr. Horner,

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Horner, who was then living, if he thought the Museum would allow me to publish them. He said he thought there would be no difficulty. I wrote to Sir Henry Ellis, who said there would be no trouble from the Museum. I proceeded with my drawing, and afterwards several gentlemen asked me to make small pieces in ivory; and that is a cast of one I have brought.—[*The Witness refers to a specimen on the table in white enamel glass.*]—I found in working on a round surface the sculpture in ivory, that every time I touched it the tool left a mark, and then I tried to make it smooth, I found, on account of its smallness, it was like labour in vain. I then thought that I could produce a better work by intaglio engraving; for by working hollow I found that I could introduce the veins and other minute work in intaglio, which must have taken immense labour upon the ivory.

871. From whom did you receive encouragement to proceed with this work?—I was doing some modelling for the Duke of Devonshire, and the late Princess Charlotte, Marquis of Lansdowne, Earl Rosslyn, &c. &c.; they had seen my drawings, and some expressed a wish to have some pieces of the frieze of the Parthenon in ivory, from seeing my drawings, which were done eight inches high, being one-fifth linear measure of the originals; the intaglios are one-twentieth of the originals.

872. How did they become cast and sold cheaply to the public in this shape?—I cut them under this impression, that I could do them better on the slate. I first published the frieze of the west end of the temple, the entire composition of which is horses and cavaliers, some dismounted.

873. In casts?—In the sculptures of the west frieze we have but one piece of marble, No. 47; it is the first piece from the salient angle of the north-west corner; it was taken out of its case in my presence, and although I protested against it in very good humour, it was laid upon the ground under a window which admitted a considerable quantity of water upon it, for two winters; it now exhibits marks of the ravages of our climate on marble.

874. Of this size?—Yes, my reductions are the 20th part of the size of the original.

875. Who were the principal buyers of the casts?—The Duke of Devonshire, the Marquis of Lansdowne, the Duke of York and George the Fourth, with other nobles, gentlemen and ladies.

876. Have you found the sale for them extend through other classes of society?—No, not general.

877. Do you consider that you would have had a great number more purchasers for those articles if the law had protected you as fully as it ought to do in your original design?—I have no doubt at all about that.

878. Do you believe the public demand for those articles is almost unlimited, if the people had free scope for them, by giving the artizans the opportunity of seeing beautiful specimens of art, and protecting the artist when, by his original invention, he has discovered any way of promulgating it?—No doubt of it; I made no secret of it, I would not find fault if he copied; but it is another thing to take my labour.

879. Your labour in this instance consisted in filling up the defects which had been created in the frieze of the Parthenon, and re-forming them on that scale?—Yes.

880. And this, like many other inventions, has been pirated, and you have not been protected from the expense of bringing an action at law, which the statute gives you, and also from the want of a tribunal of ready access?—That is precisely the case.

881. Have you had experience in taking casts from larger statues in wax?—They could be taken of any size; but I have not had experience in larger ones.

882. As to the comparative expense of wax and plaster, considering the injury that may be done to the marble by taking frequent casts in plaster, have you any thing to state?—I apprehend that plaster is more proper than wax for that purpose.

883. Have you never known the surface of the marble injured?—That must be by a person who has no knowledge of the thing, if they injured it.

884. Have you heard complaints of artists, that the fine mellow colour which is given to the marble, was liable to be injured by taking casts in plaster?—No, it will be cleaner; the plaster is a very cleansing thing, it takes off every kind of dust, and a good deal of dirtiness it will remove.

885. Would not the taking casts in plaster frequently tend to slightly alter the

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colour of the marble?—I dare say it might, but if done by one who really understood what he was doing, I would not fear any danger.

886. Would that be the case if casts were taken in wax?—I apprehend that it would be impossible to take a good cast in wax from marble.

887. Would it be impossible to take a good one from the smaller bronzes, for instance?—If it is a mould in separate pieces, it is almost impossible you can make portions of a mould in wax; but to make a mould of an entire head or figure, I think it is impossible to make a good thing of it in wax.

888. Do you apply that remark to small works of art?—Small or large; if you use the wax for taking a mould from the round, it is generally done by pressure (unless it be bas relief); with wax you could not make it good.

889. But considering always the great importance of giving the most extensive circulation to the finer works of art, do you not think it desirable that some experiment should be made, as to the possibility of taking casts in wax, with a view to the prevention of injury to the marble?—Certainly.

890. And that the circulation of works of art of the first class would tend generally to improve the taste of the people?—I have no doubt of that.

891. You would think it advisable to engage every means by casts of giving every facility to try different materials (provided they did not injure the statue), in order to circulate the knowledge of the beauty of the original?—Certainly; but I apprehend we have nothing to compare with the plaster of Paris. I would just say as to arts in general, that it would be well if we were to adopt the plan I did with the Athenæum and the façade of Hyde Park Corner, I mean cutting it on the stone at once. We generally take a model and draw out by points that which is cut in stone. Now this shows the great advantage and the propriety of having the drawings in the first instance; every practical man, if he is inclined himself, should not only be able to draw things connected with his art, but if he cannot make his tools he ought to be able to direct them to be made.

892. Supposing the labouring stone-mason were instructed in the principles of drawing, one might suppose it would tend to encourage original works of art, and produce much more accurate copies of the finer ancient works of art?—No doubt; it would not at all injure those who choose to make gods and angels, or make their works for the drawing-rooms or cabinets. There are a certain sort of minds that follow their own track; if I had had the opportunity of a school, or rather museum, I would not have been an artist, but a mechanist or engineer; my pursuit in early life was geometry and mathematics, and their application to architecture, carpentry, mensuration, navigation, &c.

893. In your own case, have you had reason to regret the non-existence of such a school?—Yes.

894. What means were adopted to preserve the frieze of the Athenæum and Hyde Park Corner, from injury from the atmosphere of London?—It was waxed; I adopted it from a circumstance I met with 10, or 15 or 16 years ago; on my arrival in London, wherever I went, I was careful to examine the condition of stone buildings, the state of the wall of Somerset House towards the river attracted my attention; I saw something projecting from the stone, which on examining I found to be a shell, and I could not help reflecting that this could not have grown out of the stone, but the wasting of the stone must have exposed it, as the projections of the shell was at least half an inch. I concluded that Portland must be very liable to destruction, from the moisture to which it was exposed in this place; from this I was induced to notice, in some places, where the builder had not been careful to lay the stone according to what is called its bed, that it sometimes split with the lamina, and fell off in large portions when the lamina stood perpendicular. When I first went to see the façade of Hyde Park, I was surprised to find the cornice in some parts in a state of decay, although not three months from the chisel. I noticed something like crystals of common salt at a place where the stone seemed in rapid decay. I tasted the crystals alluded to, and they appeared to me the taste of common salt; thinking upon this, I thought it no longer any wonder that Portland stone should be so soon in a perishable state; on this account I suggested doing it with wax. It was also my intention to have suggested the propriety of doing the top of the gate with the wax, except where it was covered with metal, which I imagined might prevent the moisture from getting into the stone, and thus have a tendency to secure the durability of the building; but the fear that such an advice might have been reckoned fishing for a job, I had not hardihood to propose it. It will soon be seven years since the façade of Hyde Park and the Athenæum friezes have

have been finished; it would be curious to inspect them to find which has best succeeded, or if either in preserving the stone. Mr. *John Henning.* 17 August 1835.

895. Were you the author of the mode adopted for preserving the frieze alluded to?—I do not know; I do not know if any other person had done it, but the first experiment I made was on a piece of polished marble; I took wax and made a stripe across it with a hair pencil; I contrived to warm it until the marble absorbed the wax, and left none on the surface. Then I mixed wax with a little turpentine, and I found that it went in further, but I found the wax went one-sixteenth of an inch into the marble. I put it on the top of the house for one winter; I found in the spring the polish was all off the marble, except where the wax was; that convinced me it must be of some use; and just about the same time I was employed to do a medallion of my friend Dr. Adam Ferguson, to be placed on his monument. I asked if the family would allow me to do it with wax; it was a piece of very beautiful statuary marble. I did it in this way, and Lord Burghersh having called on me and looking at it, he asked where I had got such marble. I told his Lordship that I had saturated it with wax, under the impression that it would preserve it in the open air; I showed him the piece of marble on which I had made the experiment, and it arose from that circumstance.

896. Does it give marble any unpleasant gloss or polish?—No; it makes it like the finest preserved old marble that ever was seen.

897. How do you apply the wax to the marble?—We warm the wax; we have the marble warm also, and I take off any thing that is upon the stone, and leave nothing but what is within the stone.

898. You warm the whole bust or statue?—Yes; and have my wax as warm as I can have it, and take the best means to get off the superfluous matter; I take it off with soft cloth, or with cotton.

899. You also dissolve it in turpentine?—Yes; but it goes in so far, the wax, by itself, that it is hardly worth while; I believe wax is almost indestructible in the open air.

900. Do you think it is better without turpentine?—The turpentine makes it thinner, and it goes further into the stone; but I think if it goes in a sixteenth of an inch, it would prevent the water getting into any stone.

901. If it were a large statue, would it answer to have the turpentine dissolved and put on the whole statue?—I would begin at the top of the head of the statue, and have the wax as warm as I could have it, and have heated irons, so that I could without touching the statue let it come down until it came to the bottom, and you must have it clean.

902. Is it fine white wax?—Yes; but I suppose other wax will do it very well for defending stone; the white makes the least change of colour.

903. What do you consider the great advantage of this application of wax to marble?—It was, as I conceived, that the water getting into the stone, froze and destroyed it.

904. You consider the great advantage of your discovery is the preservation of the material?—That was my impression; I do not know if it deserves the name of a discovery; for any thing that I know, 10,000 may have thought of and done it before me.

905. Is any other object attained by it?—Not that I know of; it takes away the glaring white of the marble, and gives a softened tone to the whole, much like the best preserved old marbles that I have seen.

906. Then your discovery is principally useful in preserving the surface from the external effect of the atmosphere?—From absorbing the moisture of the air.

907. How long does marble so coloured retain the effects?—I think from what I have seen of wax that it is more indestructible in the open air than any other material I know.

Mr. *John Martin,* called in; and Examined.

908. YOU are well known as the painter of many eminent works; in your early professional education, had you occasion to acquire a knowledge of those manufactures that depend somewhat on the arts?—Yes. Mr. *John Martin.*

909. State what branch you became acquainted with?—That of coach-painting.

910. What information can you give us on this portion of the subject?—I fear very little; only with regard to art there is great deficiency in drawing and colouring, as we know by the works on coach panels, but there is capability of a great deal of improvement, with the assistance of schools, or rather museums.

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911. It would give, you think, a greater development to art?—Supposing at museums, such as the British Museum, there were professors capable of instructing; I mean for the study of the human figure, landscape painting, architecture, and every other useful branch.

912. Have you pursued any other branch of manufacture connected with the arts?—China-painting; when I first came to London it was just going out of fashion, for it depends on fashion when not sufficiently advanced by the assistance of art.

913. What do you think of the state of art in regard to china-painting?—It is very low indeed, in consequence of the deficient knowledge in drawing and the arts in general; I believe it has gone down considerably since Mr. Muss and Mr. Marsh (who was a very eminent flower-painter at that time) left it.

914. Do you suppose that instruction is required for the artist in china-painting?—Yes, a knowledge of drawing is decidedly necessary; it was their knowledge of drawing, &c. that made Mr. Muss and Mr. Marsh so superior to others; but owing to the decline of china-painting they were compelled to leave it; and it has since entirely gone to the ground.

915. When you speak of painting in china, do you include in that enamel-painting?—Painting on china is a sort of enamel-painting but that which is generally understood by enamel-painting is the style in which Mr. Bone and Mr. Muss attained such pre-eminence; that it is strange that so splendid and truly national a collection as Mr. Bone's "Eminent Characters of the Elizabethan Age," should not long ere this have been lodged in the British Museum or National Gallery.

916. Have you turned your attention to the difference or the relative state of china-painting in France and England?—I have seen some French painting on china, and upon the whole I think the finish is much higher.

917. Do they draw better?—Yes; the French are better draughtsmen, almost in every thing; I suppose they have a better opportunity of learning; besides it is patronized by Government.

918. You think for china-painting that instruction in correctness of design is very much wanted by our artists?—Yes.

919. For instance, you mean in anatomy, perspective and proportion?—Yes, every branch of the art might be obtained in a museum where every one is permitted to go; but there are no professors in the British Museum, and the students can only learn by seeing others draw on the spot from things which are worth drawing; the Elgin marbles for instance.

920. Do you not think it desirable that an artist should possess a knowledge of anatomy?—Certainly, for the drawing of the human figure or animals.

921. Might it not be desirable to give them opportunities of understanding *ab initio*, beginning with the skeleton, and going on to the whole proportion?—Yes.

922. And the study of the muscles?—Yes, and proportion, which has never been attended to.

923. Would a young man learn all these, according to this division of labour in the art, merely by a museum?—I think so, by proper masters.

924. You would have masters?—Yes; masters are necessary to give the proper direction to the pursuits of the student; but one master might teach two or three branches of the art, as follows: one master should teach anatomy and proportion; another, architecture, isometrical perspective and perspective; a third, landscape and nature in general; indeed professors might be appointed to teach every branch of art, science and literature; as in the British Museum every thing requisite is on the spot, and few alterations in the establishment would be needed. The National Gallery, and the National Gallery of Practical Science, might become branches of the British Museum. The grand object of a student should be to divide his time so as not to lose any, and not to give too much study to one pursuit or branch of the art. I firmly believe that the arts are useful to every branch of manufacture in the land; there is hardly a branch one can name that is not useful, from the lowest to the highest state of society; even to our legislators, drawing is useful, for they are not capable of judging of a plan without a knowledge of it; and they are consequently compelled to apply to practical men, and sometimes to dull-headed practical men, who are likewise often unacquainted with drawing, to have their opinion on any new principle in plans that may be laid before them.

925. Have you any other observations to offer as to china-painting?—No more.

926. You conceive, that were the artists instructed better in the principles of drawing, by improving the beauty of their productions, you would extend their sale?—Yes,

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—Yes, and it would not depend to much on fashion as it did when it was merely a passing thing except that it would pass into other countries, and the beauty of design and workmanship would be admired in foreign countries, and be valuable in the commerce of that article.

927. At present, in china-painting, do we invent designs, or simply copy old ones already existing?—When I commenced, I invented my own designs, but that was peculiar perhaps to me; Mr. Muss and Mr. Marsh used occasionally to design their own.

928. At present do we invent as much, or copy more?—It has fallen so low, that what is done is not worthy of being called invention; the French are beating us hollow.

929. Independently of extending the sale of works of art, you would think you would confer on them a permanently intellectual interest, were the artists well instructed?—Yes; when we understand drawing, we cannot bear to look at a thing ill drawn; it affects the feelings in an uncomfortable manner.

930. Do you not think that the Wedgwood ware, which is made from the cheapest and commonest materials, by being made of beautiful forms and being covered by beautiful designs, has attained a rank it otherwise could not have obtained?—Yes, certainly; they are beautiful works of art, and though of the commonest materials, we are delighted with the forms. Painting will only interfere with the beauty of the form when it is very excellent; it is a rule in composition never to put an ugly object before a graceful one.

931. You mean that genuine beauty becomes permanent, and independent of fashion?—Yes, accidental circumstances can never affect real beauty; I have seen beautiful pieces of china in form disfigured by bad painting; in consequence of that, I have my china generally without any painting, as I like the form undisturbed; and though the other cost more, I would rather have given the larger price for the plain china, than for that which was painted, unless, the painting was good.

932. Do you think china-painting might become an extensive means of developing designs?—Yes, it is perpetually before us; every day we see china; at all our meals the elegant and beautiful china is always before us; we are delighted with a piece of beautiful workmanship, and it might be rendered very cheap if there were a great number of clever draughtsmen as china-painters, but you could not find them now.

933. Few things come so constantly under the eye as china?—No, very few.

934. Can you give any information as to the state of glass-painting?—Yes, I was more occupied by glass-painting than any other branch before I became an artist.

935. Have the goodness to give the Committee such information as you have been induced to collect on the subject of glass-painting?—Glass-painting has fallen almost to the same level as china-painting; but it might be greatly superior now to what it was in ancient times. There is an ignorant opinion among people that the ancient art of glass-painting is completely lost; it is totally void of foundation, for we can carry it to a much higher pitch than the ancients, except in one particular colour, which is that of ruby, and we come very near to that. We can blend the colours and produce the effects of light and shadow, which they could not do, by harmonizing and mixing the colours in such a way, and fixing by proper enamelling and burning them, that they shall afterwards become just as permanent as those of the ancients, with the additional advantage of throwing in superior art.

936. Do you think that the glass-painting artist wants instruction in correctness of design as much as the china-painter?—Yes, more as it is a higher branch of art; but one of the greatest drawbacks of glass-painting, and the great cause of its being neglected, is this: it is so liable to be broken, that no person can venture to pay the artist sufficiently for his labour, on account of the thin and brittle material on which he is obliged to work.

937. You think there is a want of encouragement?—Yes, or else glass-painting must have surpassed all other branches of art in splendour, as it is capable of producing the most splendid and beautiful effects, far superior to oil-painting or water-colours, for by the transparency we have the means of bringing in real light, and have the full scale of nature as to light and as to shadow, as well as to the richness of colour, which we have not in oil-painting nor in water-colour.

938. When you were employed painting on glass, did you find the Excise laws present any great obstacle to the improvement?—Yes, that was the greatest obstacle. We intended to make experiments on plate glass; I did, and succeeded with it, but the expense of plate at that time, in consequence of the heavy duty, finally put an

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end to those experiments, as we could neither afford to purchase such expensive glass, nor to erect larger annealing kilns, for if not properly annealed, the glass is liable to fly. I believe I was the only person who made experiments on plate glass; they were supposed to be successful, only I could not afford to carry them on, for the reason before given. This is the principal cause of the fall of painting on glass, but if I could have made our experiments duty-free, I should have succeeded, for the plate glass is so thick that it would be safe from being broken by ordinary means, and it has besides another advantage, that plates can be obtained sufficiently large to obviate the necessity for those bars which interrupt the present works.

939. Are the artists who pursue glass-painting now well educated in drawing?—No, the want of that knowledge has helped its decline; Mr. Hedgland, the architect, Mr. Hoadly and Oldfield, are, I believe, the principal glass painters remaining.

940. At the present time you think the cause of the badness of execution is owing to the want of education in drawing?—Partly so; I should have painted some of my own subjects, as the effect produced on glass would be particularly adapted to them, if the experiments, &c. had been less expensive. I have always regretted the cost of the experiments, as works executed on plate glass on a very large scale would have been most magnificent in cathedrals or great public buildings; the knowledge and experience we had gained from our various experiments would have enabled us to produce grander works than have ever yet been seen in public buildings. I did not leave this branch of art without establishing a mode which has been and will remain in use as long as glass-painting is an art.

941. Why did you discontinue it?—I could not get a sufficient price for a highly finished work to pay for the hazard; I painted some very highly finished paintings which were purchased by Lord Ennismore, who was very fond of glass-painting, and I finished Mr. Charles Muss's works, when he died in 1824.

942. After you left glass-painting you became historical painter and engraver, and have executed your own designs?—Yes.

943. Is there any protection for copyright in those original compositions?—Not the least; for the expense is so great, that even if we gain our action we sustain great loss, and can only recover so much as we can prove have been sold; and it is no easy matter to prove more than the sale of one or two prints, although we may know a thousand have been sold; we are therefore ruined if we go to law. I have in my own person experienced great losses from the system, as the French copies of my works are brought over from France and sold in every part of the country. I was told yesterday that various shops in Windsor had got my works lithographed and selling at very low prices, to my complete ruin; and if I am not protected by some new law, I shall be compelled entirely to leave that branch of the profession by which I live; for my pictures are so extensive and cost me so much labour that I cannot subsist by painting, as very few can pay me 1,000*l.* or 2,000*l.*, and I cannot execute them for less.

944. What is the principal defect; this expensiveness of the law?—Yes, in a great measure; it costs so much money to carry the law into execution, and as it is not exactly clear, we are not sure after all that we shall not be beaten, though our proofs are ever so good. The person may come forward with false witnesses, and swear that he did not sell.

945. But you have obtained an injunction?—No, I cannot get an injunction; I applied for one to prevent a person from exhibiting a copy of my work in a sort of diorama of Belshazzar's Feast, in Oxford-street, and that person contested it with me. This diorama was a most infamous piece of painting, and the public were given to understand that I was the painter; this was ruining my reputation, and at the same time taking that from me which ought to be my own, my copyright. I ought to have the power of demanding so much money for permission, but this copy was made not only without my leave, but my name given as the painter. I endeavoured to stop the exhibition by an injunction, but was referred to a jury.

946. Is there any remedy that presents itself to your mind for protection?—Yes; I think I could be protected with regard to the law of copyright of engravings, &c. and take this opportunity of showing how incorrect is any opinion that may prevail as to the sufficiency of the present protection; for the plagiarist is not only safe from prosecution on account of the expense of such prosecution outweighing all the advantages that can be derived from a verdict; but as in my own case, he even comes into the field with a cheaper production, supported by all the effect of the advertisements, and other expensive means of publicity that my own performances had led me to adopt. He not only robs me of my ideas, but establishes a lucrative

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trade on the effects of my pecuniary outlay; wherefore I have always thought, and I still think, that the copyright should remain in the person of the designer, so long as he lives, and of his heirs so long as they possess the works, the same as any other property, unless, of course, there be a distinct written agreement to the contrary. That it should be so is obvious, but there is not in fact any real protection to copyright, owing to the uncertain state of the law on the subject. Supposing, for example, that in the case of pirated copies of my engravings, I do by chance obtain a verdict from a jury, I can only recover the amount of what I can prove the defendant to have actually sold, which is my sole compensation for the thousands that are known to have been sold, but which it would be impossible to prove by evidence, since open book accounts of such transactions are never kept. Or take another case, of a picture being copied for a dioramic or other exhibition; suppose that on applying for the injunction, his Honour is not able to distinguish the difference between a picture of Belshazzar's Feast and a piece of lace, and leaves it for a jury to decide whether a diorama is to be considered a painting or a copy coming under the meaning of the Act; all the satisfaction I obtain is heavy law expenses, with a certainty of an enormous increase if I hazard an action. The above cases are enough to prove that there is no efficient protection; but there are many other ways of infringing a copyright, one of which is, that any unprincipled person may copy an early and most imperfect work, and publish it as if just executed, although the publication of such a puerile attempt would never have been sanctioned by the artist from regard to his own reputation. I will venture to suggest a method of protection; a committee of gentlemen and artists might be appointed to sit at the museum about once in the fortnight or month; say in the following towns, namely, for England, London, Bath, Liverpool, Birmingham, Hull and Newcastle-upon-Tyne; for Scotland, Edinburgh and Glasgow; and for Ireland, Dublin and Cork, for the purpose of receiving and registering impressions of original works, after which the copyright should be considered as fixed; and all false copies found in any part of the United Kingdom, after the copyright has been fixed, should be seized. We should, likewise, have the power of seizing all foreign copies as smuggled goods, and treating the possessors accordingly. Thus no print should be protected unless deposited at the museum, or whatever other place or places might be appointed; I think by that it would be put a stop to. I would have it at the British Museum, certainly; it would be desirable also to have them in each manufacturing town.

George Rennie, Esq. called in; and Examined.

George Rennie, Esq.

947. YOU have resided a long time abroad?—I have been nearly eight years in Italy and different parts of the Continent.

948. You have had opportunities of observing the different description of manufactures in demand in Italy?—I have; indeed I may say my attention has been drawn to this subject during my residence abroad, by observing the different description of manufactures in demand in the several countries I visited, particularly in Italy, which not being to any extent a manufacturing country, I was led to observe, that except in the plainest description of goods the French and Germans supply all the manufactures consumed there.

949. You were also led to make these observations being an artist yourself?—Yes.

950. Having devoted your attention for many years to sculpture in Rome, you naturally turned your attention to those portions of manufacture connected with art?—I was there studying my art, and I have long regretted the deficiency in knowledge of design so visible in English manufactures.

951. What is the result of your observation in the different descriptions of manufacture in demand in Italy?—I should say that the cheaper and plainer description of manufactures are most of them English, such as plain calicoes, the commoner description of printed cottons, cutlery and earthen ware; but I have found the shawls, figured silks, printed muslins, porcelain, and in fact every description of fancy goods, either French or German; though the conviction on the minds of the Italians is of superior durability and solidity in the material of the English article; I may say I have no doubt that if the English manufactures were equal in design to the French they would be preferred.

952. Has there been any improvement in design in England?—English manufactures have improved since the French were more freely introduced. I should say by imitation rather than by any invention.

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953. Do you feel disposed to assign any reason why the French excel us in th a description of goods where a knowledge of art and design is necessary?—From the facilities afforded in France for educating artists to design for manufactures, I am not aware that such means of instruction exist in this country for artists who apply themselves to manufactures as in France.

954. Do the French understand the correctness of drawing better than the English do?—They are decidedly superior to us in correctness of drawing.

955. What in your opinion would be the best means of affording the English manufacturer the ability to compete with the French in these respects?—I should say general instruction, which may be comprehended under museums and schools of art.

956. What do you mean by museums, galleries open to the public?—Yes, collections of casts, ornaments, &c.

957. In fact, works of art applicable not only to fine art but to ornament of every description, applicable to pattern or design in the schools; would the instruction you give limit itself to that which is required in the arts, that is, correctness of perspective, anatomy, a knowledge of proportion, and those branches of the art connected with botany and with chemistry?—I consider some branches of the arts necessarily require instruction, particularly anatomy and perspective. I consider it also highly desirable that every other branch of art should be taught, particularly botanical drawing. Though as to schools, I think it requires great consideration how far the Government ought to assist, because though at present it appears from the state of the knowledge of design generally throughout England, that there is an absolute necessity for some encouragement; at the same time great caution is required that too much should not be done. The effect of what I allude to, would be to establish a sort of central or general mannerism by too much legislative interference.

958. You would limit instruction to that which may be said to be positive, exact, and true in art, without allowing it to overstep those bounds?—I would.

959. Would you think it desirable to have a species of central and normal school for teaching those persons who are to teach others in different parts of the country?—Yes; I think it very desirable that some central establishment should be formed, by which I may say a central impulse might be given, without the branches being too much affected by that central influence, so as to reduce the whole to the same manner. I should say it would be very desirable that there should be a central museum in London, and in the provincial towns that there should be branch museums, where every species of casts and models, or means by which design might be promoted, should be transmitted from London to the provinces, and *vice versâ*.

960. You would have a sort of central depôt, and you would choose London as the nucleus of your instruction, because there is a greater opportunity of specimens of every kind of manufacture being seen in London, and all sorts of discoveries are immediately known both from the country and abroad sooner than any other portion of the United Kingdom?—I think so; I might exemplify it by saying, that unless there were a central system, probably one museum might become possessed of something it was desirable every museum should have; but without some general organization this could not be effected. What I allude to is casts from statues, original ornaments, &c. that could be cast, in plaster, and transmitted from the central museum to all the provincial museums.

961–2. You would have copies of works of art generally diffused?—Yes, and sent into the provinces.

963. Have the people better means of instruction by open galleries abroad than in England?—They have certainly; in fact, I might mention that in London there is not a collection of casts accessible to an artist at all; though in the British museum there are a number of very fine marbles, there is no collection of casts from the finest statues throughout Europe to which an artist can have access. The Royal Academy have a few, but the room is so small and badly lighted, that except to their own students, it is generally inaccessible; there is no collection of casts from which an artist could improve himself, and which it is desirable and necessary to have. I have felt in my own profession very much the want of such means, whereas on the Continent such collections exist in every town of any consequence.

964. You think such museums or galleries might be formed without creating any great expense?—I do, at a moderate expense.

965. Would you think it desirable to give the public an interest in them by themselves

selves being owners to a certain extent; in the country towns, you would not make it merely a Government affair?—I think it is probable the corporations might be inclined to join the Government; I have no authority for saying so, excepting the case of Coventry, the mayor of which place informed me, that he had no doubt that the corporation would willingly assist.

966. Have you observed any of the mechanics' institutions; what progress they are making?—Intimately I have not; but I am justified in saying thus far, that there is no institution in England to any extent for the application of the arts to manufactures; in Edinburgh a society has existed for many years.

967. Do you think it desirable that institutions of this kind were formed, or that those already formed were extended to connect them with museums?—I do.

968. Do you consider it would be of great advantage to the public, and increase the consumption of works of art, if galleries were thrown open and the public made familiar with such works?—I have no doubt of it.

969. Might not the casting of works of art in iron be made more extensive and useful than it is?—I am of opinion that statues or works of any kind in cast-iron might be advantageously employed for adorning public walks and public buildings.

970. You have seen the ironworks at Berlin?— I have seen casts from them; I never was at Berlin.

971. Might not a central institution be of use in exhibiting the most beautiful productions of manufacture from every part of the world?—I think it highly desirable to have exhibitions of the finest specimens of manufacture.

972. Might it not be useful in procuring from countries like China, and from Cashmere or Thibet, the product of those countries, and would it not be a great facility for doing so, being situated in London?—I think an exhibition or collection of the best specimens of manufacture from every part of the world would be highly desirable in this country.

973. Would you have any registry or depôt of patterns in a central institution or in provincial ones?—I conceive it impossible to afford the protection necessary for inventions and designs by any other means than by a deposit of the pattern and a registration.

974. You think the inventor is not sufficiently protected under the existing law?—Certainly not.

975. What additional protection would you suggest as desirable; what should be the mode by which that additional protection for them could be most practicable and would be the most simply and effectually attained?—I conceive it might be had in this way; if there were a central board in London, where a manufacturer, on producing a design, could deposit a copy and register it, that there should be branch boards at Manchester, Birmingham and all the principal manufacturing towns; and when the invention was pirated, the manufacturer should apply to the central or provincial board, who should summon the parties pirating the invention before them; and it would be desirable that the board should have a magisterial power to receive evidence on it, and convict summarily. I think the tardiness and expense of the law is one of the great causes of the want of protection at present. It would not be necessary for an inventor in London to deposit his patterns in every provincial town; for if a case arose in which an invention originating in London was pirated in Manchester, on the information of that being given, they might send the original pattern, or copy of it, to Manchester, and the offender might be convicted there; or *vice versâ*, if the Manchester invention is pirated in London, by having a central board, the pirate of the invention could be convicted here.

976. Might not the inventor deposit one specimen of his work in the local registry or with the local tribunal, and the other with the central?—Yes; supposing the invention at Manchester or Birmingham, it would be rather expensive and unnecessary to deposit copies at every board. In fact, in some cases of models, it would be so expensive as to preclude it, nor do I conceive it necessary.

977. But in the case of its being copied, to prevent its being copied in a place remote from the place where the inventor resides, would you think it fair to the public that there should be a central depôt in which every person, before he took out the patent for a new invention, before he made public a new invention, should have an opportunity of ascertaining if any thing of the kind had been previously invented?—I think it almost impossible that two people should originate an invention so exactly alike as to require such information.

978. Then would there be use in a central board?—I conceive that London being the great mart of every production, an inventor in the country should register

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at the central as well as at his provincial board, to give him more efficient protection, and I think it highly desirable that the Board should have magisterial power to convict summarily.

979. Might not that power be equally used by the local Board?—Yes, I consider the local board should have the same power.

980. Would not a local registry have the effect of stimulating the inventive powers of those artists by the registry, being open; would it not serve as a depôt, and have the effect of stimulating the inventive powers of other artists as well as the inventor?—That would, with other means of facilitating the instruction in design.

981. And raise the public taste?—I think the standard of public taste would very soon be raised, by opening a museum in every town. It is allowed that the public taste has improved greatly as regards manufactures, since the French patterns have been introduced. We may expect in the same way if museums were opened generally, the public taste would be improved, and it would give the artists the opportunity of instructing themselves.

982. Even the simple fact of there being an open gallery in which those specimens of invention of patterns were exhibited, would have the effect of diffusing the knowledge of new patterns, and of stimulating the inventive powers of the artists who saw them there, as well as those who attended in public galleries, would it not?—I conceive it would; an exhibition will always stimulate invention.

983. In fact, you think that encouragement without interference would produce very great effect in advancing knowledge in manufacturing towns?—When I alluded to non-interference, I think the danger of establishing schools is not that there is danger of giving assistance, but it is in establishing every school on exactly the same system, so as to destroy the individual character of the separate school, although I think it quite necessary there should be a central system to give encouragement without absolute control.

Mercurii, 19° *die Augusti*, 1835.

WILLIAM EWART, ESQUIRE, IN THE CHAIR.

James Crabb, called in; and Examined.

James Crabb.
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984. WHERE do you reside?—At No. 8, Shoe-lane, Fleet-street.

985. What are you?—I am chiefly engaged in the designing and the execution of fancy works, particularly with regard to the arrangement and decoration of rooms; for example, this design is my own [*producing a drawing*], and I can execute it as well upon the walls as upon a small scale.

986. You are a designer, then, for ornamenting rooms in various styles?—Yes.

987. Have you ever been induced to notice any difference between the English and French designs for papers of the best description?—We find the French papers are superior in design, both in the original idea and in the detail of the drawing; they appear to understand their subject very much better than we do in England.

988. Do you deal both in English and French papers?—Yes, we do.

989. The execution of the French papers shows that they are drawn by persons who receive a much better education in that art than anything we have in England?—In England we have no schools to obtain such instruction; the foliage of this [*producing a French paper, landscape and figures*] is very beautiful; the superior style in which the whole is executed shows that the designer must have carefully studied the aerial perspective of the colouring, as well as the general form and design; the spirit and truth of the animals surpass any thing we should accomplish for a similar purpose in England.

990. You have been induced to make these observations before you heard of this Committee?—Yes; I never heard of it till yesterday; all these specimens are prepared in our ordinary mode of business, [*producing several.*]

991. Have you, as an English artist, ever been led to reflect on the propriety of having instructions given to those who, like yourself, are engaged in works of design connected with the decoration of houses?—I am continually finding the want of it.

992. You do not find the journeymen are sufficiently instructed to produce works such as the journeymen of France produce?—Decidedly. In the instance of

of the French paper produced, the printing of it requires a certain degree of taste and knowledge in the actual application of the colours; and if we had the same blocks, I do not expect there would at present be found in the English journeymen sufficient intelligence to print or produce the whole design equal to this French specimen.

993. Explain what you have just said with regard not only to our inferiority of design, but our inability to transfer that design to the paper?—I think it want of information in the workmen. I apprehend that the workmen in France must have a certain degree of instruction given them with respect to the mixing and most judicious mode of applying their tints. In the designs for a French landscape paper, the aerial perspective is usually beautifully attended to in the printing, as well as correctness in the botanical features; and unless the journeyman had the subject familiar in his mind, he could not execute the work with the freedom with which it is evidently done; for instance, I expect that this colour, which here represents a cloud of dust, is put on in a body with a brush, and then softened and made to assume its present form with a sponge; this is the journeyman's own act, and he must have been instructed how to convey the idea, or he could not do it, especially in the distant foliage, where the same plan is pursued with beautiful effect.

994. Then you suggest two points; that the original designer for this class of paper is better than any English one, and that the inferior French workman is a better artist than the English one?—Decidedly; their taste has been cultivated and corrected.

995. This is printed by the common process of printing, is it not?—Yes.

996. By wooden blocks?—Yes; the block-cutters are not inferior to those in France; but I may say that if we had the very same blocks with which this set of paper is printed in France, we in England should not get so good and well-executed a paper.

997. You mean to say, that having the French blocks, you could not get it printed by English printers as well as this is done in France?—Yes.

998. Because in the paper printing also a certain portion of time is occupied by elementary education in France, which our workpeople do not receive?—Yes.

999. And that refers to the finishing, after it has gone through the process of block-printing?—No, this is in the process of printing; there is no superior or foreman in a manufactory who could possibly attend to all these little things, which nevertheless give the work the superiority it possesses; they must be done by the intelligent journeyman, assisted by the artist's general superintendence. In England, the landscape painter must be employed to supply such a design as this, and his time would be too costly to be employed in superintending the execution of it; we want a lower rank of ability, one that the manufacturer can afford to employ throughout his work. As regards English papers for ordinary rooms, there is a great variety of beautiful patterns published.

1000. Is the English taste for superior designs in paper much advanced lately?—Yes, I consider it has; there are finer patterns produced than formerly, especially flock papers; but we have yet as many inferior designs as good ones. I think the taste which has prevailed for some time, of colouring the walls of principal rooms a plain colour, is declining; the style of Louis XIV. and others of a rich character are being adopted.

1001. Now in the carving of the designs for picture frames and glasses, do you find the same deficiency among the English workmen that you have spoken of among the workmen connected with paper?—Yes; we find the greatest inaccuracy in the carving of fruit or flowers; we find them very bad indeed occasionally.

1002. Have you any information yourself respecting the elementary instruction of journeymen and workmen in France?—None at all.

1003. How did you attain your own skill in designs?—Principally by my own exertions; I have never had any sort of information given me; my father is a designer, and of course I have always been accustomed to see it, but I have never had any sort of introduction to works of art.

1004. Then you consider your education has been a private one?—Entirely.

1005. What benefits have you derived from any public instruction given in this country?—None at all.

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1006. There are no public schools open, or mechanics' institutions, to which you have been invited to resort by their publicity and economy?—Not any.

1007. The galleries of this country are open to you?—Yes.

1008. What galleries have you resorted to, as the means of instructing you or your hand in the execution and in the principle of designs?—The only ones are, the British Museum and the National Gallery; I have found great assistance, in respect of colour, from the paintings in the National Gallery.

1009. Since that has been established?—Yes.

1010. And therefore the inference is natural, that such galleries are of the highest importance to gentlemen engaged in such a trade as yours?—Yes.

1011. You consider it so?—I consider that the more extensive our acquaintance is with works of superior art, the more original and correct our conceptions would be.

1012. Have you been led, from your own personal experience, to think that public instruction to persons whose trade is connected with designs, would be a benefit to them?—Yes, I consider it would.

1013. That is your opinion; have you heard others similarly circumstanced to yourself express similar opinions?—Yes, occasionally I have.

1014. Did you ever obtain any assistance, by means of casts, from the better specimens of sculpture in the Museum or elsewhere?—I should derive assistance from them if I had the opportunity, but I have not time.

1015. It would be a matter of some importance to you, and those connected with the art of designing, could they obtain cheap casts of the finer statues and bass reliefs?—Yes, in many cases.

1016. What would be the ordinary education of a person intended for your profession?—He would be apprenticed.

1017. To whom?—To one who carries on the business of a designer, or decorative painter (a separate business); he would not be apprenticed to a general house of business, like Mr. Trollope's.

1018. Then after he had passed through his apprenticeship, would he be considered in a situation to commence business for himself, or would he pass through any intermediate education or study before he commenced designing?—A youth is apprenticed, and immediately is put on such work as it is found he can do inferior portions of, the patterns of his master; and he continues doing what he is able progressively; if he has ability or inclination to pursue the study of drawing in any way during his leisure hours he does it, but seldom receives encouragement and assistance to do so at any other time.

1019. What mental education is considered necessary to be given to him at the same time?—He has none; the same course is pursued through the whole apprenticeship.

1020. Then there is no knowledge of the antique given; any classical allusion that he makes in his designs is quite chance?—Quite chance.

1021. Supposing that you were set to design a series of decorations, and were given a particular subject to exemplify, for instance, the history of Cupid and Psyche; supposing that you were not possessed of more than an ordinary degree of information in your profession, how would you proceed to execute those designs?—I could not do it.

1022. Then if you had an order of that kind, would you be obliged to have recourse to artists not connected with your own profession to give you the designs?—If I had an order of that sort, and I found that the French paper of that subject executed, and now existing in France, would not answer my purpose, I should inquire of English artists by profession their charge for designing such a subject, and of the printer the cost; but I apprehend that the cheaper way would be to go to France, where without difficulty I could obtain both the design and the paper made to my order.

1023. Then you suppose that in France gentlemen in your profession would themselves have requisite knowledge to execute works of the kind, without having recourse to an artist?—Yes, their pencil would be sufficiently correct.

1024. Then art is cheaper and goes lower in France than it does here?—Art is more general, and it is cheaper from being better and more universally understood.

1025. Then it should seem, that provided you had the design, you could execute it afterwards in this country?—Yes; but in both cases at much greater expense.

1026. Then

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1026. Then we are only inferior in designing, not in the execution of designs?—In the execution of such a paper as that we are inferior [*alluding to a French paper*], because they have more intelligence among the workmen.

1027. Does that arise from having so many colours upon it?—It arises from the taste which is necessary to execute the subject; you do not see much of it here, but in some parts the distant foliage is very good indeed.

1028. Is any part of this done with a pencil?—None.

[*The Witness exhibited a Drawing of his own to the Committee.*]

1029. In the drawing which you have now laid before the Committee, the Committee perceive it is taken from the Elgin Marbles; did you draw this from the original or from casts?—I drew that and others from an engraved outline, and corrected it by occasionally visiting the Museum, and on my return correcting my drawings.

1030. Is there any engraved outline of this size?—No, it is 20 inches high.

1031. Then how did you execute this; did you enlarge from a smaller copy?—Yes, I enlarged from one about four inches by six.

1032. Do you find an increasing taste for subjects of this kind?—If I had time and opportunity I should pursue them, and expect patronage from gentlemen of taste.

1033. But is there an increasing taste among general purchasers; do you observe a greater demand for patterns or specimens of the antique taken from Pompeii, or from the classical models, than there formerly was; is that taste increasing in the country?—I think it would increase if there were opportunities for satisfying it; but the expense is at present too considerable for general patronage.

1034. Might not one means of increasing it be the diffusion of elementary education in arts and designs, so that you might employ men at a cheaper rate capable of executing works of this description?—Decidedly; for instance in that pattern [*alluding to the drawing of the Elgin Marbles*], having had no instruction as to the general proportions of the horse and the figures, the difficulty, supposing I had a quantity to execute, would be very considerable, because I must make drawings of the whole to a scale first; now, if I were more conversant with the proportions, I could execute it without, and in that case I could make quite as much money, and the work would be done cheaper, by being done with facility.

1035. Now to what purpose do you propose to apply paper of this pattern?—The idea was to introduce them below the frieze in a dining-room, or on staircases, in sunk pannels.

1036. So as to produce the effect of a bass relief?—Yes.

1037. And you think if paper of such a pattern be executed cheaply, that is, if our journeymen workmen could assist in executing such patterns, that there would be a great demand for them?—They certainly would be then extensively employed, either painted or printed; we should have an opportunity of employing them now, but for the expense of executing.

1038. Do not the pattern-drawers for calico printing furnish you with many patterns?—We borrow from each other.

1039. That is, you copy their patterns from printed furnitures?—We copy their ideas, although the actual design may not be copied.—[*The Witness exhibited another Drawing to the Committee.*]—Now that is applicable to our business, but not at all to calico printing; that is an arrangement, an idea of colouring of my own, the subject done from an outline engraving.

1040. Is it the practice of your trade to have patterns furnished by the calico printers?—It is not.

1041. It is a distinct business?—Yes.

1042. Do you find a want of instruction in architecture?—In every branch of decoration.

1043. And is it your opinion that schools or institutions liberally established for the purpose of instructing persons like yourself in the correct principles of design, and in extending their knowledge of the arts, would be very beneficial to them?—I consider it would, by enabling them to express their ideas with freedom.

1044. Is this drawing that you have handed in to the Committee done by yourself?—Yes.

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1045. In all its parts?—Yes.

1046. Is it copied from any original done by any other artist, or is the design yours?—The design is mine, but the paper itself is a French paper.—[*Some more Drawings were handed in to the Committee.*]—The drawings which I now hand in are drawings to a scale, from a paper designed by Mr. Jones (who is one of the first decorative artists), in the copying of which, the reducing to a scale, I find there are inaccuracies, which, if that gentleman had received an architectural education, I mean to a limited extent, suitable for decorative painting, he would not have committed. This drawing is a French design for a dome ceiling; it is printed in perspective; we have nothing of the kind in England, and its drawing and general execution is very superior.—[*Two more specimens were exhibited.*]

1047. You have two specimens there before you, one French and the other English?—Yes.

1048. Is one a copy from the other?—No, but I apprehend the mode of printing the English one has been copied from the French one, from the mode in which the French one is done. I apprehend these specimens of French paper were imported for the purpose of assisting the printing of English paper, not for this pattern alone, but various others which have been introduced by the same house in the same style as this French one.

1049. What do you consider to be the best qualities of that French paper?—The superiority of the drawing, the elegance of the lines, and the variety which is given to the colour.

1050. Is it more true to nature?—Yes, that is in the correctness of the drawing.

1051. In fact, there is a better knowledge of botany in it than in the English one, is there?—Yes, there is none at all in the English one; no knowledge of botany shown; in the French there is decidedly.

1052. Is that English paper of the botanical pattern which you have just compared with the French one, of the best of English paper, or not?—It is the best of the kind.

1053. Have you any other practical illustration to hand in, or any observation you wish to make with regard to flower-drawing?—Yes,—[*Some more were exhibited to the Committee*]—these are all French flower borders, which are very well executed; they are most beautifully drawn.

1054. Do you think in England they would be so well done?—No; I think that one of the best we have [*exhibiting another.*]

1055. Then you exhibit a pattern of the best English flower-drawing for paper border, and what, in your opinion, is the difference between that and the French one that you have before you?—In the English pattern, the leaves are not those of the flower, which is an inaccuracy that we never find in the French; they use the leaves of each respective plant with the finest possible effect.

1056. Now with regard to the colour, are the colours of the two patterns different?—Yes, the French are superior in brilliancy.

1057. What is your opinion with regard to the effect and combination of the colours of the flowers?—The effect, contrast and combination of the colours, as well as form, are superior in the French; this facility of adapting the forms and colours most gratifying to the eye, must be the result of early and continued acquaintance with flowers and plants.

1058. Where are these French papers made?—In the neighbourhood of Paris.

1059. Can you state any thing as to the comparative price between Paris and England of similar papers?—I do not know of any bordering in England that we can get to use for the purpose.

1060. You have said it is desirable that the manufacturing population in your line should have some instruction as to the mixing of colours; how would you propose such instruction to be given?—I am not aware of any information that is given with respect to the harmonious arrangement of colours; for instance, here is a drawing, and there are others amongst those in which the colouring is entirely my own idea, but it is done without rule. In France they would do it on a fixed principle. I am not aware of that rule, except just in a superficial way. The French colours are also themselves more brilliant than any printed English ones I have yet seen.

1061. By rule, do you mean certain proportions?—No; there are certain

quantities of colours which must be used in certain places, in order to produce a good and judicious effect.

1062. There is a principle established then, is there?—In all the fine paintings of the ancient masters you find an equality of colour, and it is the same in our work; but we are not instructed; we labour till we obtain an effect that pleases our eye; and this is as often wrong as right.

1063. Do you mean in France, there is any thing like elementary instruction in the science of colouring, for decorative artists, &c.?—No doubt there must be.

1064. Have you any positive knowledge of it yourself?—I judge from the effects produced.

1065. Have you any further observation to make on the specimens you have brought with you?—Nothing further than upon the general want of information which we find. My preceding remarks are not limited to printing, but apply generally to interior decoration.

1066. Is there any want of talent among those who, like yourself, pursue this branch of trade?—I apprehend not.

1067. It only wants free scope given to it, and proper instruction?—Exactly, they want opportunities in early life to make themselves generally acquainted with the various proportions of the human form, animals, architecture and especially botany, and the principle of combining colours to form pleasing effects.

1068. You have never been in France, have you?—No.

1069. Then you form your opinion, not from having been in France, but simply from the works you have seen, both English and French, in this country?—Exactly; and the deficiency I find for want of such public instruction as I apprehend might be given to all branches with success.

1070. With regard to the decoration of rooms, or any other subject of the kind, do you wish to express any opinion you have been induced to form?—No; we find constantly that there is a person who must be consulted in the decoration of the room, and it is very important that that person should have the information which I state is wanting in England with regard to true taste and fine combination in the colours and design to be employed.

1071. Then the principal deficiency is the want of correctness of drawing?—A want of an easy and correct mode of obtaining the knowledge of it.

1072. The want of knowledge of perspective?—Yes, as applied to decorative works.

1073. The want of knowledge of architectural drawing?—Yes.

1074. And what other head?—The want of knowledge of the principle of colouring; we have no certain principle to go upon; all these advantages may be obtained in England at present, but at a great cost; they are not attainable by those whom it is necessary should have them.

1075. In the practice of their trade?—I mean in the general use of our business; there are works of art, engravings and works of great merit which will never come under our observation, although we know they are in existence, and would be of invaluable assistance; they are in the libraries of architects and men of superior fortune and talent, and we have no access to them, which, if we did have by means of a public institution, the general taste would be wonderfully improved and extended; it furnishes able men to direct the student, and is a repository for fine examples of art.

1076. You believe the general labour in a paper-hanging manufactory is inferior to the French manufactory?—It must be.

1077. And therefore it is desirable that the journeyman manufacturer should have a degree of information which our journeymen do not possess?—An intelligent manufacturer, I apprehend, at the head of a business of this kind, would give to his foreman and principal workman opportunities of obtaining that extended knowledge which might be obtained in England through a public institution; he would make a point of doing so for his own advantage.

1078. Provided there was a place open for their instruction?—Yes; now a botanical garden would be of the highest value; for there is scarcely any thing where, in some form, botany is not introduced, and the more extensively you are acquainted with it the better; you get more beautiful lines, more original effects and finer forms than you do by any other means; and the same with foreign birds; occasionally you have fine birds and colouring to introduce, and

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where you have an opportunity of studying them at your leisure from nature you can, when required, introduce them and other objects with facility. We find no colouring equal to that of nature; the illuminated missals are also applicable to our business.

1079. You want extended power of observation by facility of access to every work of the kind which you describe?—Yes.

1080. And that would draw out a great deal of talent which is now not drawn out?—Yes; I apprehend superiority in all branches; we should be able to amass a stock of ideas to be combined and varied as occasion might require.

1081. Would it be a great advantage to you to have the means of studying the drawing of birds from nature itself in the Museum, &c.?—Yes, it would; and it would be still an increased advantage if we were allowed access to it early in the day; I can avail myself of no advantage unless it is before breakfast.

1082. Now, with regard to the British Museum, supposing you could have access in the summer from six to eight, in order to design from any of the statues of marble or friezes there, would or not that be great advantage to you in your trade?—It would; it might be a very great advantage.

1083. If it were open to you to pursue information and acquire knowledge at a time that you could beneficially spare it for that purpose?—Yes.

1084. In the morning and also in the evening?—Yes; but in the evening with less advantage.

1085. Then if it were so open to you, you would go there in fact?—Certainly.

1086. And you apply that generally to other collections of art in which your ideas might be assisted in general?—Yes.

1087. And do you conceive that your observation applies to other persons in the trade as well as to yourself?—To all situated as I am.

1088. You are so engaged throughout the day, that it would be an essential benefit to you to visit these galleries and places or public institutions in the morning or the evening?—Yes, morning or evening.

1089. Have you ever made any application to the Trustees of the British Museum with a view to being admitted early in the morning in order to study the antiquities, &c.?—I have not; I have not had occasion to apprehend it was necessary. But supposing that I had had a series from the Elgin Marbles to execute [*alluding to the Drawing before shown*] in a gentleman's house, then it would have been of the greatest importance to me.

1090. Then supposing you were to have an order for paper with the design you have put in, being a design taken from the Elgin Marbles, you would then find it a great advantage to have an opportunity of frequenting the Museum early in the morning?—Yes.

1091. And should you in that case make application to the Trustees for permission?—As it now stands, I should certainly, though I do not apprehend it would be granted.

1092. Have you ever turned your attention to the embossing or ornamenting of leather in lieu of paper for rooms?—Yes, but without success.

1093. Have you ever seen any specimens of ancient leather so embossed and ornamented?—Yes, I have, many.

1094. Is it an art at all followed or understood in this country at present?—Not to the extent that it was, not for rooms; it is merely for the backs of superior books, and various things of that kind, but to no extent.

1095. It used to be made in this country for rooms, did it not?—No, principally in Holland.

1096. Upon the whole, is paper-hanging increasing?—The taste for superior decoration is increasing; in noble rooms it is the style and whole effect that marks our taste, not merely the paper.

1097. Is its consumption increasing?—The consumption was always very large, but I think the taste wants more general improvement with regard to the adaptation of the patterns, the arrangement of the paper and its embellishments, a particular always attended to by the French, than in the execution of our ordinary bed and sitting room papers. There is not sufficient knowledge among the master paper-hangers as well as the inferior workmen, the persons who direct the work; there is not that taste there should and might be, by more

widely diffusing a knowledge of the beautiful effects to be produced by combination of colour. *James Crabb.*

1098. And you are persuaded that the more general knowledge of the artist would tend very much indeed to increase the consumption and improve the arrangement of all these domestic embellishments?—Yes, not only with respect to the executors of the work, but those who propose to have it executed; with the general public there would be a better taste. 19 August 1835.

1099. Are there any other points on which you wish to observe?—I am not aware of any thing further that I can add beyond the idea that a gallery for exhibiting works of original design would be an advantage.

Veneris, 21° die Augusti, 1835.

WILLIAM EWART, ESQUIRE, IN THE CHAIR.

James Skene, Esquire, called in; and Examined.

1100. WHAT are you?—I have been secretary to the Board of Trustees for the Encouragement of Manufactures in Scotland since January 1830, and am also secretary to the Royal Institution for the Encouragement of the Fine Arts in Scotland. *James Skene*, Esq. 21 August 1835.

1101. Have you had any opportunities of acquiring information with regard to the advantage which manufacturers may derive from an increased knowledge of the arts of design?—My opportunities in that respect have been during the greater period of my life; I was educated abroad, and stayed in one of the foreign academies of design for three years, when a young man, and since that period I have been about ten years in different countries, and being fond of art myself, I have paid considerable attention to that subject.

1102. Will you state to the Committee when the Board of Trustees was instituted, and what is the constitution and object of that board?—The Board of Trustees was instituted at the time of the Union of England and Scotland; in consequence of some alteration that took place in the customs and duties connected with the two countries, a sum of money became due by England to Scotland, payable to different establishments and different individuals. The surplus of that sum was appointed by Government by the 15th article of the Treaty of Union to be employed in all time coming for the encouragement of manufactures in Scotland. That was the first establishment of the Board of Trustees in the year 1807; at that time an annuity of 2,000*l.* was appointed to be paid for seven years to the board. That was the first grant. The board, nevertheless, was not established till the year 1727; there came to be accordingly arrears of that 2,000*l.* for seven years, which made 14,000*l.*, which was then paid to the board, as also a sum of 6,000*l.* of farther arrears after the annuity had been made permanent, and laid the foundation of their funded property. The grant of the 2,000*l.* was then rendered perpetual, and they have ever since received that sum.

1103. What is the whole amount they receive?—Various alterations have taken place in their proceedings, and their funds have been considerably augmented; some of their funds being in the public securities during the war, and exceedingly well managed, considerable savings were obtained by that means; so that now their funds consist, in the first place, of the annuity of 2,000*l.* payable by Government; they have the sum of 30,000*l.* at present in the hands of the Water Company of Edinburgh, for which they receive the interest; they have 15,000*l.* in the hands of Mr. Innis, of Lochalsh, also yielding interest; they have a sum of 1,000*l.* in the hands of the town of Edinburgh, which at present yields no interest, as the town is bankrupt. They built the Royal Institution, a large building in Edinburgh, for the purpose of accommodating different learned bodies there; the Royal Society, the Royal Institution for the Encouragement of Arts, and the institution for antiquities (the Antiquarian Society as they call it), and also for the accommodation of the Board itself; they receive rents from those other societies which amount to the annual rent of 740*l.*: that constitutes the fund.

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1104. What is their annual income applicable to the purposes of the Board?—

[*The Witness delivered in the following Paper:*]

PRESENT STATE of the FUNDS and EXPENDITURE of the BOARD of TRUSTEES for MANUFACTURES in *Scotland*.—*J. Skene*, Secretary.

THE Board of Trustees for the Encouragement of Manufactures in Scotland derives its origin from article 15th of the Treaty of Union between England and Scotland, in terms of which a sum having become due by England to Scotland, as an equivalent for certain alterations in the respective revenues of the two countries, a portion of that sum was converted into an annuity of 2,000*l.* redeemable by Parliament at any after period, by payment of 40,000*l.* This annuity, or its redemption price, to be employed in all time coming for promoting the fisheries and manufactures of Scotland.

The annuity having been allowed to remain in arrear, until the Board of Trustees was actually constituted in the year 1727 (13 Geo. I. c. 26. 30.) the arrears being paid up, gave rise to the funds now in the hands of the Board, and to which subsequent additions were from time to time made by savings, the advantageous sale of stock in the public securities, and of property purchased at a low rate for the purposes of the Board, and afterwards sold to very great advantage.

A further sum of 2,956*l.* 13*s.* 8*d.* was granted by Parliament under the Acts 10 & 27 Geo. III. for promoting the growth of flax and hemp in Scotland, but this sum has now been withdrawn by Government; and a further reduction of the funded property of the board took place, by an order to pay out of that fund the sums of 8,000*l.* to the Botanical Garden, and 1,000*l.* to the Astronomical Institution of Edinburgh.

The present state of the fund, of the burdens affecting it, and of the sum remaining for carrying on the purposes of the board, are as follows:—

	£.	s.	d.
1. The annuity, payable in discharge of equivalents due to Scotland	2,000	–	–
2. £.30,000, bearing interest, 3½ per cent.	1,050	–	–
3. £.15,000	525	–	–
4. £.1,000 in the hands of the Town of Edinburgh, not yielding interest at present	—		
5. Rent of the Royal Institution, built out of the funds of the Board	740	–	–
£.	4,315	–	–

The Fund is burdened as follows, by Grants ordered by Government:—

	£.	s.	d.
1. To the Royal Institution of Arts	500	–	–
2. To the Agricultural Museum	300	–	–
3. To the Horticultural Garden	200	–	–
An annual sum, payable as compensation annuities to Stamp-masters deprived of their offices, by repeal of the Linen Acts	1,076	–	–
The Drawing Academy, including feu-duty of ground	430	–	–
Further expense in coals, lighting, taxes, repairs and contingencies	230	–	–
SALARIES to Officers of the Board:			
The Secretary £. – – –			
First Clerk 420 – –			
Accountant 240 – –			
Allowance for house to ditto 50 – –			
Messenger 50 – –			
	760	–	–
For new casts and other expenses attending the gallery	100	–	–
Sum left for promoting the objects of the Board, and covering incidental expenses	719	–	–
£.	4,315	–	–

N.B.—It is to be observed that the annuities to Stamp-masters, as most of them are men of advanced age, will progressively fall in for the benefit of the funds of the Board.

1105. What means have been taken by the Board of Trustees to extend the knowledge of the arts, principally of designs, among the people of Scotland, particularly the manufacturing population?—The principal means which the Board have followed for that purpose has now been in operation for about seventy years; about seventy years ago they established a school for drawing, being

being aware of the advantage which foreigners possessed over this country as teachers of design at that period; they got a person of the name De La Croix, a Frenchman of considerable skill, who set that institution a going; it was for the accommodation of forty pupils taught by one master, and the pupils are admitted gratis. They offer specimens of their capacity and certificates as to character to the Board of Trustees, and they judge of those who are to be admitted, giving the preference to those who seem the most deserving of it. It is an establishment which very soon rose into great repute in the country, and has continued exceedingly successful ever since.

1106. Has the number of pupils increased?—The number of pupils has not increased; it still remains the same establishment, with only one master. It has been managed since the period of its first establishment by a series of very eminent teachers. The person who now holds it, Mr. William Allen, is the first artist in Scotland. The Board contemplates extending it, and they are at present taking measures for that purpose. Hitherto it remains on the same footing, only forty pupils, but so great is the demand of the public for the extension of it, and so high does it stand in their estimation, that although there are about four or five elections of pupils in the course of the year, there generally are at least ten candidates for every single vacancy that occurs, and it comes to be a matter of very disagreeable administration to the Board to reject so many young men from having instruction in the art of design, when they seem desirous to obtain it.

1107. Do these young men afterwards devote themselves to that part of designs connected with manufactures?—They are principally engravers and statuaries, also artists, coach-painters, house-painters, and manufacturers; persons of that kind.

1108. Do you happen to know whether Mr. Wilkie was educated there?—I believe there is not an eminent name in the history of art connected with Scotland where the individual has not been educated at that academy. It has produced the most eminent men, either as artists, engravers, or as connected with any of the corresponding professions; in fact it has done a world of good to the country.

1109. Do persons recommend young men for introduction to that establishment from the distant provinces?—Oh, yes, from every part of Scotland.

1110. Will you state how they are selected?—They produce specimens of their talents for drawing; they produce certificates of their good character; the Board is very particular upon that subject: also if they are apprentices they produce certificates from their masters that they will give them the means of attending, and then all these are examined by the Board of Trustees; and that young man whose name perhaps they are ignorant of, but that young man whose qualifications seem best, is the person elected. The only preference they seem disposed to give is to the younger classes of them in preference to older ones.

1111. Do you know if Mr. Wilkie was educated there?—Certainly he was.

1112. Any other engraver do you recollect?—Mr. Barnet, Mr. Wilson, Mr. Allen himself; in fact all the artists of any eminence connected with Scotland have been educated there.

1113. This school and the Royal Institution are at Edinburgh?—Yes.

1114. Have there been any subordinate schools in any other part of Scotland connected with the Board of Trustees?—The Board of Trustees established a branch school for the express purpose of teaching the pattern drawing for table-cloths, diaper, and matters of that description, at the town of Dumfermline; it was upon a particular system, and the Board engaged to give fifty pounds a year to a master, provided the manufacturers of Dumfermline would contribute an equal sum. They did so, and that school was in operation for a good many years; I do not exactly recollect the number of years, but for a good many years, and was exceedingly beneficial, and, in fact, was one of the great causes, in conjunction with the encouragement of premiums for the best articles of manufacture given annually by the Board, of raising the establishment of linen manufactures in the town of Dumfermline. Last year the manufacturers declined contributing any further to it, because it had been reduced to a few only, who contributed their proportion, and these few, two or three of the manufacturers, said the burthen was too hard, upon them, and they could not contribute any longer, wishing the Board to advance the whole sum of one hundred pounds. That was incompatible with the idea the Board had of ensuring

ensuring the establishment which they fostered, being one beneficial to the manufacturers themselves, that they themselves should give the whole sum, and therefore they declined giving it, and that school has accordingly fallen.

1115. Then the contributions from the manufacturers fell so low, that the Board would not contribute their proportion?—Yes.

1116. But if the manufacturers found it advantageous, why did they discontinue their contributions?—They found it advantageous, but the whole body of them were disinclined to contribute to it. There were two or three who continued to contribute to the last, but they found 50*l.* a year was more than they were disposed to give. The master could not undertake it under 100*l.*, and the Board was not inclined to give above 50*l.*, which they originally proposed.

1117. Has any school been substituted for that of Dumfermline?—None.

1118. Not by the inhabitants themselves?—No.

1119. Have there been any schools established at Glasgow, Kilmarnock or Paisley, or anywhere there?—Not that I am aware of.

1120. Do you think they might be established with advantage?—I think with the very greatest advantage.

1121. Has not the shawl trade somewhat decreased at Paisley and that neighbourhood?—The shawl trade rose to a very great height till about a year ago, when considerable failures took place among those engaged in that trade; they attribute those failures to the introduction of the French shawls; whether that is the case or not I cannot say, but they are not now so flourishing as they were years before.

1122. Do you know whether the superiority of the French shawls has resulted in any respect from the superiority of the patterns or of the designs?—The designs of these shawls are almost confined to the Indian patterns; but I believe it is the general opinion, that the French have exceeded even in that respect the English in their patterns, because they have turned their attention to it in a more efficient manner. There is a school at this moment in Paris, where about seventy pupils are instructed expressly in that particular branch of shawl patterns, taught by a person who has written a pamphlet on the subject; and I believe the price of their shawls is under that of this country.

1123. There is no school at Paisley then, is there, connected with the shawl trade?—I am not aware that there is.

1124. Can you tell whether the Mechanics' Institution there give any instructions of the kind?—I am not aware; but the Board of Trustees being aware of the deficiency in that respect, has now sent an exceeding clever artist to Paris, for the purpose of gaining information upon that subject, whom they mean to introduce to the Academy at Edinburgh, and to establish a class for that especial purpose, not for teaching shawl patterns alone, but patterns in general connected with manufactures.

1125. You have stated that it would be an advantage to have branch academies established in the different manufacturing towns in Scotland?—So far as my judgment goes.

1126. What do you think would be the best footing for establishing those?—It appears to me that the best footing to establish those would be to have a system of instruction; a centrical establishment upon a regular system, which should not be deviated from in any respect; I have not any doubt that in a very short time a number of students would be raised in that centrical establishment, who might then be sent to the different parts of the country where they might be required, and establish branches in communication with the centrical establishment, and under the same regulations and the same superintendence.

1127. You would have a central school?—Yes.

1128. That at the same time would serve not only as a school for instruction, but also a kind of *haut ton* for the most recent improvements in all the different combinations of art connected with manufacture?—Yes; I should be disposed to extend it pretty far in that respect, particularly to make it an establishment of different classes. One of the great defects in the mode of instruction in this country is, that the first branch of art, namely the fundamental one, is that which in this country is neglected; that is what is called drawing from the round; it is, in fact, the rudiments of design, the most indispensable, although the most neglected; except the Royal Academy and that academy of the

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Board of Trustees, I am not aware any other teacher of drawing does really adhere to that system which I know in French academies to be the only system that is taught, because they conceive, and it has been the opinion, I believe, of artists for many generations, as well as the old masters, that that is the only species of study which is requisite to form an artist. If he has once acquired a knowledge of drawing from the round, or drawing from objects of beautiful outline, and containing means of light and shade, that he is enabled then to turn his talent to any of the branches that he may require without any further instruction. In this country we seem to take a secondary part of it; to take instruction in a more advanced part, and neglect the rudimental part.

1129. And, in fact, is it not true that in correctness of drawing the human figure, and in the knowledge of proportions, we are very deficient?—Very much so in general; and on that account I would make it a rule of that establishment, that the first class should be that one in which instruction is given in chalk drawing on a large scale from the round, having a series of second classes where the different branches connected with the useful arts were taught, which covers very many; architecture and all other branches connected with the useful arts, ornamenting, decorative, house-painters, and so on.

1130. And in an establishment of that kind you would not only make the fundamental principle (correctness of design) the object, but also what may be termed the perspective in botany, and those things which are connected with certain sciences which may be called positive parts of art?—Yes; and it appears to me a very little instruction, perhaps a few lectures, on this, as far as it is applicable to the useful arts, would be sufficient; that is, on anatomy, chemistry, optics, with reference to colours, and botany. It appears to me there is a very great defect in general in our patterns, in botanical accuracy, where flowers are introduced; the foreign pattern-drawers are uniformly correct; our pattern-drawers very seldom so.

1131. Would you sub-divide your institution in another way?—Yes; I would have a third class for the higher branches and for the purpose of artists; but that confined alone to men whose object in life was to be artists.

1132. But in such an institution as that, would you not have a certain subdivision of instruction, so that pupils coming there, and wishing to devote themselves to the study of casting in bronze or in iron, or studying modelling silver, or turning themselves towards pattern-drawing on cotton or on silk fabrics, might have the means, after a certain time, of turning their undivided attention to any particular branch of that kind?—Yes, comprehending the requisite acquaintance with the manufacture itself.

1133. So that they might go out from the institution, having chosen that division of the subject most suited to their capabilities; they might go out as manufacturing artists, to accomplish the particular object which they felt themselves most particularly qualified for?—That is my view; and the purpose I should have in dividing it into classes would be this, to in fact repress an error which those academies are exceedingly liable to fall into, and which the academy of the Board of Trustees in Scotland has already fallen into; that is, of neglecting those parts of the study which apply to the useful arts, and dedicating their attention alone to the higher branches; in fact, making all the pupils study as artists, and not as men to pursue useful branches of occupation.

1134. In fact, is it not true that it is an exceedingly dangerous thing to pursue, in such institutions, those portions of art which may be said to be connected with individual taste or individual genius, since the tendency of so pursuing them must be to neglect those portions of art which are positive and true, and founded upon unvarying principles of art?—Yes.

1135. How would you propose to prevent the tendency that you have described?—I consider that the division into classes might produce that effect, because, if the first class is imperative that no pupil could enter the academy without going through a course of that first class, then he would be enabled to turn his talent to any branch of design he might choose; he may then quit the academy. If he chooses to follow out the pursuit to the highest branches by the recommendation of the master, he may be permitted to do so; but it has been experienced in those academies in Scotland, that many pupils who come there with a view towards the useful arts have quitted it and become artists themselves.

1136. And do you think that that has gone too far?—I think a great deal too far.

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1137. And do you think that the sub-division into classes would be sufficient to correct that?—With precise rules on the subject, which should not be deviated from either by the master or the pupil.

1138. What do you reckon would be the expense of such subordinate drawing-schools, and how might it be defrayed?—It appears that the expense of that academy in Edinburgh, where forty pupils are taught, is exceedingly moderate; the master receives 150*l.* a year, and there is an officer receiving 50*l.* a year; and with taxes and lighting and fire, and so on, there are some other expenses, but of no great importance, and that is the whole amount of it.

1139. Supposing subordinate schools were established at Glasgow, Paisley, Kilmarnock, and other manufacturing towns in Scotland, what expense do you reckon they would be attended with?—I should conceive that a sufficient master would be found at 100*l.* a year, to carry on the establishment.

1140. Might it do for a master at certain times to make circuits through the manufacturing districts, and give instructions for three months, or some such period?—I rather doubt that, drawing requires a little time.

1141. You think it would require a continuous master?—Yes; although it does not require very great labour on the part of the master, it still requires a certain degree of superintendence, that he sees what the pupils are doing; but it appears to me, the more numerous an academy is, the more advantage the pupil derives from it, because he improves by what he sees his neighbours doing; it does not require much labour on the part of the master, but it requires a person to be able to correct where errors occur. In that school of forty pupils I have not any doubt that at any period six or eight might be drawn from it perfectly capable of teaching the art of design.

1142. Then you think instruction should be local, or fixed in certain portions of Scotland?—It appears to me so.

1143. Do not you think it very desirable, on the supposition that these establishments were formed and connected so with the mother establishment in Edinburgh, that publicity should be an essential ingredient of all their proceedings, and the state of the school, the number of pupils, and accounts of the funds should be annually laid before Parliament?—Clearly I think that would be attended with the greatest possible advantage; it would interest the public on the subject, and the interest of the public is very much wanted.

1144. Are there reports annually made by the Board?—Reports are made to The King; that is to say, to the Treasury. They are not made to Parliament at present, but they might easily be extended to Parliament.

1145. Has any thing been done for pattern-drawing in Scotland by the Board of Trustees?—The Board established prizes for pattern-drawing in their academy, and a good many very creditable specimens have been, within two or three years, produced; but there is one deficiency there, which shows the necessity of teaching for that matter, which is this; that many of those patterns that were exceedingly beautiful, were not altogether adapted to the operative part of the manufacture; the persons were not conversant with looms, not conversant with manufactures in fact, and therefore they require the means to be provided of having recourse to a master, who can instruct them in the working of the fabric, whatever it may be, to which their pattern has been employed.

1146. In fact there may be said to be a peculiar intermediate branch between the original design and the invention of that design in the manufacture, which should have separate instruction of itself?—Yes; but it does not appear to me that it is necessary to be an intermediate branch, because the artist may himself be instructed in that matter.

1147. In France the workmen is more an artist than in this country?—The system in France is very different from this country, because in France the artists of the first eminence employ their time, and make it the most profitable part of their employment in pattern drawing, and they are paid a very high price by the manufacturers. There is a legislative protection to their work, which in this country we have not, and yet it is of great importance; so that for a year (I believe that is the period) both the manufacturer and the artist is quite sure of his pattern not been pirated. It appears to me, that some legislative interference in that matter would be almost necessary to go hand in hand with any establishment for encouraging the art of design amongst the middle class of society in this country, that they may be protected in the production of their genius; otherwise neither the manufacturer can afford to risk the loss of the pattern,

pattern, or to pay a large sum for the pattern which he may lose, nor can the artist risk it.

1148. And would it not be desirable to draw certain distinctions in the degree of protection to be given; some articles requiring one period of protection and others a shorter period?—I believe that is the system in France.

1149. And is it not also desirable that there should be a tribunal, before which a speedy and a very cheap remedy should be given in cases of piracy of patterns?—I am not quite conversant with the French system; I do not know how it is administered; I know that it exists, and answers its purpose.

1150. But on general principles, would it not be exceedingly desirable that a speedy and cheap remedy should be given to the inventor of a design?—Clearly; and that should be perfectly cheap; a small sum to be paid for the right of proprietorship.

1151. Not only would you have an adequate tribunal, but you must also have some satisfactory mode of identifying the design?—Yes.

1152. Have you turned your attention to the best means of doing that, by registration, or by mark, or any other means?—I have thought on the subject; I am not altogether prepared to give a specific answer to that question at present, because it is one requiring some consideration; but I do not see any difficulty in devising the means of doing it.

1153. You have not turned your attention to the propriety of establishing any system, local or central, or a combination of both, for the registration of such original designs?—I have thought on that subject also; I think if any thing of the kind is done by Government, of extending the copyright law to those smaller periods, that it would require to have means of registration in the different portions of the United Kingdom, at all events in the metropolises.

1154. Has any thing been done to improve the knowledge of colours; do you think those engaged in manufactures in Scotland require improvement in that respect?—It appears to me that one thing in which the British manufacturer is most deficient is that of a knowledge of colours; at present, as far as my acquaintance with manufacturers goes, I believe they copy entirely their patterns from France; in doing so, if they introduce any alteration into them they often spoil them; and it is a matter which is not a very difficult one to obtain a knowledge of, the theory of colour; but it is one which appears to me a very singular circumstance that it is not sufficiently attended to, because we know quite well that any deviation from the regular established and fixed rules of harmony of colours, produces the same effect to the eye as any deviation in music from the harmony of notes. It produces an equally bad effect; and in placing our manufactures or fancy goods along with French fancy goods, it has often struck me as a remarkable circumstance to see how very little those rules which are exceedingly simple, are attended to in the English copies. That was my reason for suggesting a lecture on that part of the subject, on optics, in fact, on colours, at those schools; for the rules are simple, but quite necessary to be known to any person who has occasion to place colours in juxtaposition.

1155. Are the French dyes superior to ours?—They seem to me to be very much superior.

1156. In brilliancy or permanancy, or both?—In brilliancy; as to permanency, they have two species of them, permanent colours, and colours not permanent. The one is sold at a much less price than the other; and I believe a great deal of their goods which are exported, are not permanent in colour. The Swiss are also very superior in point of dying.

1157. Do you think the Board of Trustees would be able, with their present funds and means, to establish such schools in the manufacturing districts of Scotland?—The funds of the Board have been very much reduced this last year; they are now exceedingly small, but they are at present engaged in measures for the extension of that very object, because it appeared to the members of the Board that that was the most essential requisite for the improvement of our manufactures, because it is obvious to every one that in point of excellency of workmanship the British manufacturers have risen to the highest pitch; it is only in the taste of design in which they are deficient; therefore the Board of Trustees have particularly directed their attention to that subject, as their

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funds have been so much reduced that they do not see they have the means of doing much else.

1158. Do you think it probable that something will be done by the Board of Trustees in the course of a few months?—In the course of this ensuing winter I expect that a good deal will be done on the subject.

1159. Would it not be very desirable to connect institutions of this kind directly or indirectly with botanic gardens, so that the pupils might have the means of studying flowers and acquiring a correct knowledge of natural flowers?—Yes; I know that the French pattern-drawers have the flowers before them. I believe, in this country, when they do make patterns, which is not very often, they take any book of travels containing flowers, which may or may not be correct; but I know the French artists copy from the flower itself, and that, being in the hands of skilful persons, it is always botanically correct.

1160. Might it not be desirable, if it were possible, to create some connexion between such institutions and botanical gardens?—I think it decidedly of importance.

1161. Has that ever been proposed?—No, I never heard of its being proposed.

1162. How many lectures on botany do you think would be necessary for artizans?—I cannot say exactly the number, but I should think very few; it depends on the person giving the lectures; the subject may be concentrated; all that is requisite for the useful arts may be concentrated so as to be delivered in a very few lectures.

1163. Should you think, generally speaking, that there would be any objection on the part of botanic garden institutions to allow such connexion to exist between institutions connected with arts and botanic gardens?—I should think not, as far as Scotland is concerned; the botanic garden is in a manner under the control of the Board of Trustees, who of course might, if it were requisite, insist upon that.

1164. Might it not be possible to connect institutions of this kind, not only with botanic gardens, but also, to a certain degree, with institutions in surgery; for instance, anatomy and other branches; do not you think it would be desirable, if it were possible, to unite institutions of this kind with other institutions connected more particularly with science and art?—I can have no doubt as to the beneficial effect likely to result from it; how it might be brought about, I am not quite aware, except by employing persons; there are only professors; I am perfectly persuaded of the advantage that would arise from it.

1165. Do you think, on the whole, that there has been an improvement of late years in Scotland, both in patterns and in dyeing?—Yes; I think the improvement in matters of taste in general has been very remarkable in Scotland within a few years, and in dyes there has been a very great improvement; since the Board of Trustees have given premiums for that special purpose, there has been a very conspicuous improvement. In patterns the improvement has also been obvious, but not so very great as yet, because there is no instruction given in it; the young men who present these specimens of drawing are left to themselves, and they frequently go wrong in many particulars; it appears to me there is a great deficiency in the want of instruction.

1166. Are any lectures given on that subject?—None.

1167. Would you state what is the extent of the prizes given by the Board of Trustees?—The Board of Trustees give 24*l.* a year to be divided into prizes for the young men. There are six prizes for ornamental drawings, and six prizes for drawings from the round. The young men produce the first and the last of their performances during the season, in order that the Board may be able to compare their progress; and these are kept in the possession of the Board, not returned to the young men. They are also exhibited to the public.

1168. Would you state what prizes are given by the Board of Trustees for improving manufacturers' patterns?—These are very numerous and vary from year to year, according as the state of manufactures and the state of the demand for manufactures seem to require, also according as it appears to the Board that there are particular branches of manufacture which might be conveniently and advantageously introduced into the country; therefore the premiums which they have offered have varied from year to year. Their principle is, that they shall not continue to give premiums for a longer period for the same purpose than what is quite sufficient to introduce it; when once it is introduced they suspend the

the premium, because they consider that if it cannot maintain itself after that it is not worth encouraging.

1169. Will you state to the Committee for what subject of arts they have chiefly been given?—Formerly there were a great many premiums given for the purpose of the linen manufacture; these have now been suspended. There are many premiums given for the woollen manufacture; for all the branches of that manufacture. Within these two or three years the Board have particularly turned their attention to matters connected with woollen manufactures, to the branch of carpet manufacture; and they have been the means of very much extending that branch in Scotland by the introduction of three or four new descriptions in the branches of manufacture which never were known in the country before, never practised in Scotland at least, and which have been most successfully introduced, and are now rising into great reputation. They have also turned their attention particularly to the subject of the shawl manufacture; a number of their premiums were dedicated to the shawl manufacturers, and amongst others, being aware of the disadvantage which the shawl manufacturers were exposed to from drawing the yarn used in that manufacture from France, and from France alone, because it was only there where it could be spun, the Board of Trustees offered a high premium for the introduction of the art, and have succeeded in introducing it; and it is now established in Glasgow and Leeds to an extent which I believe now supplies the market as quickly as the French agents did, who do not come now to this country for that purpose.

1170. What was the amount of the premium?—The amount of the premium was 300*l.*; it was the largest premium which the Board ever offered for any subject, and they consider they have done a very great benefit to the country in having succeeded in that scheme.

1171. What is the nature of the improvement that has been introduced in carpet manufacture?—They have introduced the system of making carpets in imitation of Turkey carpets, because they are made of coarse wool, which is more suitable. Their view was the consumption of Scotch wool, which is coarse wool compared with the wool of England, Saxony and other countries; the view of the Board was to extend the market for the Scotch wool, and therefore they introduced the manufacture of Turkey carpets, which has been exceedingly successful, and has very much increased the consumption of that staple of Scotland. They then extended it to the Persian carpet, which is a different fabric also, and that has also been successful; there are a great many looms now employed solely upon these branches. I cannot altogether say, but I believe the carpet manufacture has very much increased in consequence of the introduction of all those different branches. They introduced also the tapestry mode of making carpets in imitation of French carpets; they also introduced the making of carpets from cow-hair, which is an article that formerly was not used in any shape but in that of mixing lime; in fact it was of no use.

1172. When was that introduced?—That has been introduced two years; the premium was offered about three years ago; the yarn was spun generally in the gaols and correction-houses, and those sort of places, by the people who were there, and carpets have been produced of exceedingly good workmanship, and very useful for many purposes, particularly for shops and for lobbies, and purposes of that kind. It is a coarse manufacture, but a very useful one.

1173. Is it peculiar to Scotland?—Altogether peculiar to Scotland; the idea, in fact, occurred to myself; I had seen the use of cow-hair in making rugs and things of that kind in Flanders; and I suggested that improvement, and it has been adopted.

1174. But does not this improvement rather apply to the texture than the design?—The texture entirely; the design is that of the Turkey and Persian carpets, but that has improved the art of design a great deal, because being a new subject, the artist has bestowed a good deal of attention on the subject.

1175. What is the difference between the French and Scotch designs for carpets?—The French design is what is called tapestry carpets, which has also been introduced into Scotland. The Scotch have now imitated that French pattern I think with very considerable success. Those require botanical accuracy above all things, because they generally are groups of flowers thrown down on a dark ground.

1176. And is there not a much greater variety of shades of colour?—Much greater; formerly in the Scotch manufacture, and I believe in the English also, they could not introduce above four colours, except by mixing the threads;

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except by mixing a thread of two different colours. I know that from a circumstance which was mentioned to me by a colour manufacturer in Scotland; he had arrived to the extent of introducing fourteen colours, or tints, which was conceived to be almost impossible; however he was a very ingenious man; his name his Whitock, and he set himself to work and he has very much augmented the number of colours now introduced into patterns. In that respect and in the circumstance of design, and the beauty of execution, I think he stands preeminent.

1177. Has any attempt been made to introduce what the French call velvet carpets?—He has done it, and very successfully, and has obtained a patent for that express carpet. He has sold the right of making that carpet, I believe, to some English house.

1178. Does not that require a wool of much finer texture than what is generally used?—No doubt it does; Scotch wool is quite unfit for it.

1179. What is the wool they use for that, do you know?—I cannot precisely answer that question.

1180. Could you state what might be the prices given for some of the best Turkey carpets made in Scotland lately?—No, I cannot.

1181. Do not you think that a central institution might be of great service, not only in teaching designs and in collecting different designs, but also as a sort of depôt for any thing which might be new in any part of the world, and which might be collected as connected with arts and manufactures?—Certainly.

1182. For instance, the subject you just mentioned with regard to the wool, the premium given by your institution for the wool, which they could not have originally procured, but which they now procure from France; might it not be the object of such a central institution to acquire from all parts information of that kind, and to make their establishment a kind of depôt for all such information?—Yes, I think so.

1183. For instance, there is a mixture of gold which the Chinese often have to work in japan trays, and which we do not know of; it might be very advisable for such an institution, whether it was in London or Edinburgh, or Dublin, to make it one of its objects to collect such articles as those?—I have always been desirous for some years back to introduce something of that kind into the establishment of the Board of Trustees, but the diminishing of the funds entirely put an end to the idea. I had made some progress in preparing for an establishment such as the Committee has suggested.

1184. And in any Report that should be laid before Parliament annually, the novelties of that kind introduced, and the activity therefore provided on the part of the institution, should be specifically mentioned in the Report to Parliament; any new thing of that kind in which they had extended the means of improving our arts in material as well as in design, might also be mentioned annually, as it would give a stimulus to the activity of the institution, mentioning that in the Report to Parliament?—I think it would be attended with great advantage, because it would promulgate the existence of the thing, which otherwise is not known. In case I may have been misunderstood in what I said with regard to the wool which the Board introduced as referring to the shawl manufacture; it was not the wool, which is the Thibet or Cashmere wool, which is in fact imported into this country, exported from here into France, there spun and re-imported into Great Britain; it was the art of spinning merely, which is a different mode of spinning, that the Board introduced.

1185. Where is it spun in this country?—In Glasgow and Leeds. It is a patent manufacture, and the patentee is in Glasgow; he has disposed of the right of spinning to a house in Leeds.

1186. Do not they spin that in France?—In France they do. This is the French mode of spinning, and the French supplied our manufacturers entirely with that article; now, our manufactures are supplied from home.

1187. Do you mean the wool of Thibet?—The Thibet wool; the Cashmere wool. As connected with the subject of spinning Cashmere wool, it may be worth while to mention that the same system of spinning is applicable to all the finer wools, the Merino wools and all the finer wools; and has by this establishment recently introduced in Glasgow, been extended to all those fine wools; they not only spin those wools, but they begin to manufacture the finer fabrics for ladies' dresses, which were formerly imported from France alone; they now manufacture them in Glasgow in consequence of having obtained the mode of spinning the yarn.

1188. How far does the Royal Institution contribute to the improvement of the

the arts in Scotland?—The Royal Institution is now connected with the Board of Trustees, in consequence of an arrangement which took place about four years ago. Therefore the Board of Trustees have obtained access for their pupils to the library, containing works on the fine arts, and every thing connected with that subject; they also have the privilege, for the pupils of the academy, of attending their gallery of pictures, and copying pictures there, and studying as they choose.

1189. Would you state what is the collection that the Royal Institution have of pictures, of casts, of engravings, and of books?—The Royal Institution have no casts; it is merely confined to pictures; it is a private institution supported by private subscription, and they have expended the whole of their funds in the purchase of the pictures of the old masters, of a collection, not a very large one, but an exceedingly good one, of paintings, which is now open to the pupils of the academy of the Board of Trustees. The gallery of casts consists of about one hundred excellent casts of the finest works of antiquity; they have also the Elgin Marbles, and have received a number of presents and legacies of different works of the same character. They obtained the originals from Lord Elgin; a great many of the casts which he had taken at Greece of different buildings, which are now in the collection of the Board of Trustees.

1190. Are these galleries open to the public?—They are open to the public; to the artists always; to the public on certain days, but always to the artists, and always to the pupils of the academy at all times.

1191. How many of such open galleries have you in Edinburgh, galleries of art?—Only these two, the institution and the academy of the Board of Trustees; there is also the Scotch Academy, an association formed by the artists themselves, not yet a chartered society; and they have annual exhibitions of their own pictures.

1192. What open galleries or collections of works of art have you in Scotland open to the public?—There is one at Glasgow; I am not aware of any other but that and the one in Edinburgh.

1193. Do not you think it very desirable indeed that such institutions should be formed?—I think most desirable.

1194. And that they should also be entirely open to the public as much as possible?—Clearly.

1195. Do not you think it very desirable that such institutions should not only be open in the middle of the day, when the rich can devote their time to the inspection of works of art, but as much as possible at early hours of the morning, and also the evening, when the labouring population may wish to go there, not only with a view to recreation, but also to instruction in their own art, as far as they are connected with art?—The only difficulty that occurs to me with regard to that is the want of light.

1196. But in the summer?—In the summer, certainly.

1197. And as far as it might be practicable, in the winter too?—It would entail some additional expense, but I do not see why that should be an obstacle to it. There would be some additional expense for attendance. To the great facilities that occur abroad of exhibition of works of art, I attribute very much the proficiency that exists in foreign countries in the knowledge of design, and in the higher scale of taste that exists among the middling classes of society abroad, compared to what it is in this country, for here it seems to be confined to the higher class alone almost.

1198. Have you any exhibitions in Scotland for the exhibition of works of art, such as ingenious patterns and manufactures, or ingenious specimens of weaving?—That intention was contemplated, but never has been put in practice.

1199. Was it from any disinclination on the part of the artizans to send works to such exhibition that that intention was not carried into practice?—Not precisely; nevertheless I understand that there does exist an indisposition on the part of persons who have made inventions or improvements to exhibit them, from the circumstance that they are aware that they have no protection; that their invention and the property of their improvement is not protected.

1200. There is an exhibition of carpets and silks?—Yes, an exhibition of the competition goods for the prizes given by the Board of Trustees.

1201. Would you describe that?—The Board of Trustees for the encouragement of the manufactures of Scotland offer annually a series of premiums for improvements

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improvements in different manufactures, also for inventions, should any take place. Those are annually exhibited to the public, and judges are appointed from among the manufacturers, who examine the goods and award the premiums. The circumstance that induces the manufacturers to attend very much to that, is that by obtaining the premium for their manufacture, they obtain the means of publishing, very much to their own advantage, the species of trade that they carry on; otherwise the premium is a very small one, and scarcely worth the while of a manufacturer to work for it.

1202. Have these exhibitions generally tended to improve the arts in Scotland?—They appear to me to have done a very great deal of good, so much so that within these five years they have progressively increased, so much that five years ago a very small apartment contained the whole; now the large picture rooms of the Royal Institution are not sufficient to contain the goods.

1203. Have you turned your attention to the French triennial exhibition of works and manufactures?—The French Exposition? yes, I have turned my attention a good deal to that; and a paper of mine, communicated in one of the printed reports of the Board on that subject, gives a particular account of that establishment in France, and of the advantages derived from it.—[*See* Appendix, No. 1.]

1204. Do you think it is advantageous?—I think it is highly advantageous. Where it enjoys a very great advantage over any attempt in this country, is that the improvements of the year, and the inventions of the year, are by the French manufacturers expressly reserved for that exhibition, because they know that they are safe in producing their new design, whatever it may be.

1205. Are the specimens of manufacture exhibited in the institution taken away at once, or left there after they receive the premiums?—The period is but a very short one that the exhibition lasts, not above three weeks, and as soon as the premiums have been awarded by those appointed judges, the exhibition is open to the public, with the prices stated on each article, and the goods are sold.

1206. For what period?—For about a fortnight; the first week is taken up in examining for the premiums, and then there is a fortnight for the public.

1207. Would it not have a better effect on public taste if they were left for a longer period in the institution?—I have not any doubt of it. There is a reason which has hitherto prevented the Board of Trustees doing so; they are desirous of doing so, but they have been prevented doing so, because these premium goods are generally bought by the trade in Edinburgh, and they are anxious to get them into their shops and exhibit them as fast as possible.

1208. Does the determination of the judges always give satisfaction?—Generally; I have never heard of any dissatisfaction in consequence of it.

1209. Do they extend to patterns as well?—Yes.

1210. Not only to the materials, but to the patterns?—There are premiums for patterns of all descriptions, and for the manufactures also.

1211. And also for inventions?—And for inventions.

1212. And machinery?—There have been premiums offered for machinery; but there has not yet been any produced, because the inventor of the machinery is afraid to produce it.

1213. Could you ever trace the talent that has gained the premiums to the institution at which that talent has been instructed?—Almost always.

1214. Are you aware whether the manufacturing artists from Scotland have been induced to go to foreign countries to study?—I am not aware that they have, because they have not as yet considered the pattern-drawing as a trade; in fact, it is considered a trade, and a very important one, abroad; but it is not yet taken up by the Scotch artists.

1215. They have not gone to Bruges or different places on the Continent, where they receive cheaper and more extended instruction in art?—I am not aware of their doing so.

1216. Or have any foreign artists come to settle as designers of manufacturers in Scotland?—No, I am not aware of any.

John B. Papworth, Esquire, called in; and Examined.

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1217. WHAT are you?—An architect.

1218. Where do you reside?—At 10, Caroline-street, Bedford-square.

1219. You are very familiar with the interior decoration of houses, are you not?—Quite so.

1220. That

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1220. That is what you have principally devoted your attention to?—No; to architecture generally; and having a very great love for the art of ornamental design, I have paid very considerable attention to it.

1221. Do you consider that sufficient encouragement is given in this country to the art of general design?—No.

1222. What distinction would you draw with regard to the encouragement which is given to general design and the encouragement which is given specially to painting, sculpture and architecture?—Painting, sculpture and architecture have a certain quantity of employment, for which they receive payment for its execution. Another branch of art, that is, ornamental design, is very little encouraged, because the manufacturer (not being protected from piracy), if he pays an artist a large sum for that which he performs, another person may very soon get possession of the design, and use it for himself, and therefore the first manufacturer gets little or no remuneration.

1223. Is the manufacturing artist well instructed in this country?—No; and I know of no public school of instruction for him in London.

1224. Is he as well instructed as on some parts of the Continent?—He is not. On some parts of the Continent he is well and publicly instructed; the manufacturers in the working of gold and silver, and the ornamental works which relate to the embellishment and decoration of houses, have frequently been obliged to apply either to sculptors, painters or architects, and have been so furnished with designs, for which they have paid considerable prices, because they have not been able to find artists in general designs that could answer their purpose.

1225. Then you mean that the manufacturer is obliged to have recourse to a higher scale of artist than he need have recourse to if proper instruction were given?—Precisely so.

1226. Is art, so applicable to interior decorations and to manufactures, cheaper in France than in those continental nations which have made this their object, than it is in England?—Considerably cheaper on the Continent.

1227. Then you consider the defects in art, as applied to manufactures, principally derived from two sources, the want of instruction and the want of protection?—I think chiefly the want of protection, because there are a great number of clever artists in this country, sculptors, for instance, who would occasionally model a tablet, a frieze or some other work of art, would cast and sell the work in such numbers as would produce remuneration to the artist; but if he were now to let one such cast pass out of his hands, it would be sold probably about the streets in a week or a fortnight for 2*s.* or 3*s.* He is not protected sufficiently to allow him repayment for the work that he performs with so much care and study. In this country, if an architect wanted to find a modern vase, a modern tablet or a modern frieze of very fine art, he might therefore seek it in vain.

1228. Are the producers of these designs better protected abroad?—I understand they are.

1229. Have you ever devoted your attention to the best means of protecting inventions of this kind?—I have; a protecting law, as of copyright, would perhaps be the best means; but it is important that there should be a place with the means to teach ornamental art; a place of instruction that would also display examples of the very finest works, ancient and modern.

1230. Is it not the case that nearly all the good models are to be found in foreign countries?—Of modern art, yes.

1231. Then is it not the case that an architect or an artist has not sufficient time to devote to acquiring a knowledge of that art before he finds it necessary to turn his time to account in the production of original works?—Yes; a student of course must first make himself capable to produce works of fine art, and much time and instruction is essential to this attainment. Then if he were encouraged to proceed by knowing he should be paid for that which he published, he would employ his talent, or it would find employment; but feeling he shall not be remunerated because ornamental art is not adequately protected, he does not sufficiently cultivate it, and the public loses the benefit of his talents.

1232. But is it not the case that the time and trouble necessary to acquire a thorough knowledge of the art, is more than professional men have the opportunity of devoting?—It is certainly; if they had the same means in this

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country that they have abroad, it would be a saving of much time; I am alluding to the art of ornamental design, not to painting, sculpture or architecture.

1233. What are those branches of manufacture which create the chief demand for the assistance of artists?—They are the gold and silversmiths, manufacturers of ornamental furniture, of works in metal, carving, ornamental glass, in china, and in house decoration generally.

1234. How do these branches of manufacture obtain assistance from artists connected with manufacture, or do they go beyond that for assistance?—They frequently go beyond it; for superior designs they go for assistance to painters, sculptors and architects, but at a cost of expense to the manufacturer that has considerably lessened his demand upon those artists, and there have been but few others on whom he could rely.

1235. Do you consider that our designs in gold and silver are very much improved of late?—I think they are very considerably improved within the last 25 years, and from the employment of painters, sculptors and architects.

1236. Are we superior, equal or inferior to any foreign country, in our designs in gold and silver?—I think our classic designs may be considered equal to many of theirs, but we have not many eminent chasers in this country, and our castings in metal are therefore too gross in many instances.

1237. Do the silversmiths abroad resort for designs to artists of as great eminence, as they are in the habit of resorting to in this country?—I am not sure of that, but they do resort to some artists of considerable eminence abroad who have assisted the manufacturers occasionally; but I believe that has been more from works in art being executed immediately from their designs for their employers, and not from being employed by the manufacturer to design it for them; sometimes, however, the employer is the manufacturer.

1238–9. Now the manufacturers of ornamental furniture, to whom do they have recourse for designs?—They generally employ a person who has been a carver, or some young man who has shown a talent for drawing in their way, and he is led on, bit by bit, without any public school of instruction, to put together certain ornamental parts, and thence to make new matters.

1240. Are they obliged to pay very high for designs also?—Yes; if they go to the higher branches of art for them.

1241. Do you know whether the French manufacturers of ornamental furniture pay high for designs?—I think not, when they go to professional designers for them.

1242. Therefore there is more art in ornamental furniture manufactured in France, than England?—Yes; a great deal.

1243. In fact art comes down more into the manufacturing workshop in France than it does in England?—Considerably more; they seem to have an art of design in employment, perfectly in union with their manufactures; in fact, art dwells with manufacture more in France than in England.

1244. Do you make the same observation with regard to ornamental glass?—That is employed in but very small quantity; the changes are few, but in this country some changes have been made, and very important ones, by the assistance of the higher professors of art.

1245. Now with regard to china and house decoration generally, do you also extend the observation you made as to the want of art being combined with manufacture, and forming a portion of it, to china and to the decoration of houses?—To both.

1246. Do you consider that if the knowledge of art were more extended into the regions of manufacture, such as you have mentioned, that the demand would much increase for the articles which they designed?—I should think it would considerably.

1247. And do you generally think that extending and cheapening art, would extend also the demand for art?—I have no doubt of it; and with regard to the prior question, I have reason to believe that our want of good designers and sufficient workmen, capable of executing the several ornamental works at a moderate expense, are true causes why we get a great deal of that very old matter of furniture from abroad, which arrives in ship-loads, and which is adopted instead of new furniture, much to the disadvantage of our designers and our workmen.

1248. There is a class of artists called pattern-drawers, employed by calico-printers,

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printers, paper-stainers, silk-manufacturers, carpet-makers, and many others, is there not?—There is.

1249. Do these persons show much originality of design and correctness of drawing in their patterns?—They do not.

1250. Upon what resources do they depend for the articles introduced by them?—They generally depend on the articles that are introduced into England from foreign markets, but this supply, readily obtained by manufacturers, sometimes supersedes artist-like employment altogether.

1251. Then the supply of these designs from foreign markets is the effect of the want of instruction in these pattern-drawers themselves?—Exactly so; if the Committee will allow me, I will put it in a shape that will make it rather clearer; I will imagine that a piece of silk is brought over to this country and is seen and looked at; the merchant approves and sends it to the manufacturer; the consequence of which is there is, no employment for a draughtsman or a designer for that piece of work, and the articles that are so introduced pass to almost every manufacturer, and shut out the employment of original designers.

1252. Have you had an opportunity of knowing what assistance the manufacturers principally want for their purposes; have you heard them complain of the want of any particular assistance they require?—They want, in every case that I have found, a protective law; if they had that, they would not need to despair.

1253. Do they require any additional information in design?—They are very desirous of having it; manufacturers lament exceedingly the want of adequate assistance for their purposes in design; judgment, accuracy of drawing, and in knowledge of and arrangement of colour; and they would readily pay, even for the best assistance, if the use of that which they pay for, was by law so protected to themselves, for a reasonable time, that they might have reimbursement; but it has often happened, when a manufacturer paid for a good design, and (as for metal work) had the pattern carved at a considerable expense, intending to have it executed in silver or some other valuable metal, that from the dishonesty of his workmen, another person has forestalled him, by bringing out the same thing in lead or cast iron.

1254. Then piracy in such cases is very common?—Very common; piracy is so common in works of art, even of architectural ornament, that artists will not execute a fine design on their own account, well knowing that as soon as they sell one plaster cast of it, they have no further hope of benefit, and thence the absence of original matter in vases, tablets, foliages, &c. of which England possesses few or none that are worthy of observation.

1255. Have you ever turned your attention to the best mode of accomplishing this protection?—I presume that it would be on the principle of patent-right, allowing every manufacturer a patent-right for a reasonable time, in proportion to the nature of the article that he produces.

1256. And then what mode of identifying the article for which the patent was obtained would you pursue?—It strikes me that it would be proper that certain competent judges should be established for the purpose of ascertaining the points of fact whether it is piracy, or whether it is not; but there are two sorts of piracy; for instance, a sculptor models a bust, with a Roman robe on the shoulders; some one gets possession of this, and publishes it altogether; that is a complete piracy. But another man will remove the robe, and substitute another piece of drapery; he then calls that no piracy; and there have been many injuries done to artists by that and similar circumstances in many branches of the arts, and in engravings particularly.

1257. An invention of that kind is, to a certain extent, protected by Act of Parliament?—Yes, it is protected, as far as it applies to whole piracy; but partial piracy is sometimes followed, and I do not find that that is sufficiently opposed by any present law.

1258. Is not the remedy also given by Parliament an expensive one?—Yes.

1259. And the designers are deterred, in consequence of that expense, from protecting themselves when they otherwise would do?—Very frequently; and in consequence of the expense.

1260. Do you, therefore, consider it essential that protection in a cheaper mode, establishing the right of the original inventor, should be afforded?—I do.

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1261. Would it not be a hardship, and rather injurious to art, to confine particular combinations of nature to the first person who might happen to have formed them?—I should think it would be so.

1262. Then you do not extend your remarks to the first person who may happen to hit on particular designs?—No, but to the design and work together.

1263. Have you turned your attention to the best mode of identifying the designs for which the copyright has been taken out?—I have not.

1264. What has been the consequence of this absence of protection on the style of manufacture?—The absence of protection has induced manufacturers to seek a style of ornament capable of being executed with facility by workmen unpossessed of theoretical knowledge, and without practical accuracy. This style has been fostered to a great extent, and erroneously termed that of Louis XIV., but which, in fact, is the debased manner of the reign of his successor, in which grotesque varieties are substituted for classic design; and it is admitted that designers and workmen of very mediocre talents are preferred to better artists in this kind of work, for it is little amenable to the criticism of the judicious, and the workmen are usually free from the trammels of artist-like education.

1265. In fact, it is what the French call the style of Louis XV.?—Yes.

1266. Most of the designs passing in this country under the name of Louis XIV. are the mere spurious designs of his successor?—Yes.

1267. But then the Louis XIV. style was very various in his early days?—Yes, the early style of Louis XIV. was a very bold, a very sumptuous and a very grand style; it was adopted with avidity, and there was a great demand for it in his magnificent reign; it thence became debased, even in that reign, by the employment of meaner workmen; but the grand designs of Louis XIV. were essentially different from those of Louis XV.

1268. What does the superior character of the design in the early part of Louis the Fourteenth's reign proceed from?—In the early part of Louis XIV. it seemed as though the Roman style was not sumptuous enough for his purpose, therefore he demanded designs of a more extravagant, a bolder and larger character, and of more sumptuous expression than the Roman style afforded; but the Roman and Italian styles, made more sumptuous, is the style of Louis XIV.—[*The Witness exhibited two small Prints of the different styles.*]

1269. What you call the Roman style, is not that the style of Michael Angelo?—Yes, that and the style from which he studied, but the moment that the grotesque scroll, so common in the works of Louis XV. was introduced, it interrupted the chasteness of the Roman style.

1270. Have not the French lately devoted their attention to a style of art which they call the style of the Renaissance, or the early style which prevailed when the arts again began to dawn in Italy?—I understand they have, but I have seen nothing of it.

1271. Is not the style of what you call the flowing outline capable of being executed by people who have no freedom whatever of hand?—Of the Raphael style, certainly not; but artists of mediocre talents can design and execute the grotesque scroll-work with ease.

1272. And does it not owe its prevalence to the facility of its execution?—It does; it is easier manufactured; it is often manufactured by putting bit and bit together of heterogeneous matter to form a new whole.

1273. That requires neither taste, imagination, nor freedom of hand?—Very little, or none.

1274. Is that what you call the scroll style?—I would term it the grotesque scroll style.

1275. Then should you apprehend that, as this style has so long usurped the place of true art, you would have some difficulty in finding workmen capable of performing ornamental classic works?—I have experienced great difficulty in finding capable workmen for works in the best styles.

1276. Define more exactly what you mean by the classic or pure style of art?—Such works in ornamental art as were executed by the Grecians, Romans and Italians, and which have long been accredited as the offspring of high and cultivated taste, and as practised by Michael Angelo and Collini, as designed by Le Pautre and others, and given in valuable documents by Piranessi; this style is almost lost to this country and to its manufactures.

1277. Have

1277. Have you ever turned your attention to the best means of reviving, or rather of creating, a more pure style among our artists?—Very recently, within a year or a year and a half, I have, in conjunction with other professional men, been very much concerned in forming an institute of British architects, which has now got into operation. The very views which this Honourable Committee take, had already influenced the members, and who were not aware that this subject was likely to occupy the attention of the House of Commons. In that institution we shall endeavour to improve the art of design from fine examples, getting together a collection of antiques, and offering rewards, not merely for the copying those antiques, but for composing new designs in that spirit.

1278. Is your institution connected with instruction?—We have no school, but we propose to have lectures upon the subject, and I believe it will be very soon established, so that we shall have good modellers for the students, or rather, I should call them, the younger members. They can draw already, we shall have good modellers for the purpose of teaching them how to do works by their own hands, for when they have learned that, we shall find them able to instruct others whom they may employ. I think that result would follow of course, but such means of improvement as may follow the labours of this Committee, I think most likely to assist artists in every way, and the benefits of which will pass through the whole manufactures of the country.

1279. Have you ever turned your attention to the best mode of instruction to be adopted, to the extent or the mode of instruction?—Not particularly to that object perhaps, but drawing in general, and modelling, seem to me to be the two chief accomplishments towards obtaining the end desired; modelling is very important.

1280. In the works which have come under your view of foreign and English artists, do you consider that there is any characteristic difference between them?—Yes, very great in those that relate to the manufacturing arts.

1281. Which do you think superior?—The foreign.

1282. By foreign do you mean French?—I mean French chiefly.

1283. You state generally, you think it very desirable that instruction should be extensively given to manufacturing artists?—I do.

1284. You have not devoted your attention particularly to the mode or nature of instruction?—I have not, further than I have already stated.

1285. Are you also of opinion or not that it would be desirable that they should have galleries of casts, and collections of beautiful specimens of art open to them, as much as it is practicable, at all times, both to the artist and to the pupil?—I think it most desirable, and it also struck me that another means might be of very considerable advantage to artists in ornamental works. If an exhibition was to be created annually or otherwise, as might be considered best, of such works of fine art as gentlemen might please to allow to be exhibited for the benefit of artists, some in London, some in Edinburgh, and some in Dublin, I think it would have great influence on general taste.

1286. But does not that exist in the British Gallery at present?—No; I do not allude to works in painting and sculpture, and the higher departments of art; but I mean an exhibition of vases, casts, bronzes and works of decorative architecture; for one of the events to be feared of an exhibition is, that by those higher departments of art, where human figures are the chief matter, young men might be tempted to leave the intended object to pursue that which is more accredited and honoured, and to the disadvantage of the manufacturing arts.

1287. But do not the public attach greater importance to works of art than they did some years ago?—Yes, very considerably.

1288. As far as the ornamental decoration of houses, both external and internal, are concerned, have our houses improved of late years?—I am not aware that they have, and I think it arises from this circumstance, that ornamental works in houses of the finer and the higher class are omitted, because we have not sufficient nor more able artists to execute them at a moderate expense. In consequence some of the very finest works in this country, in point of proportion and of design, are without the ornaments that belong to the Italian, the Roman and the Grecian style of decoration.

1289. You mentioned that an institute of British architects has been recently established; was it established in consequence of the want of sufficient instruction in other institutions?—No, it was not; it was founded for the purpose of facilitating the acquirement and diffusion of architectural knowledge; for the

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promotion of the different branches of science connected therewith; for establishing an uniformity of practice, and maintaining a high respectability of character in the members of the profession; numbers have joined it. We have had some large donations from gentlemen; and we have thence felt that we could carry it much further, and purpose to foster the art of design as much as we possibly can.

1290. Is not instruction in architectural design afforded by the Royal Academy?—They have schools for drawing the human figure and for painting and also for perspective, but none for ornamental designs.

1291. Are you acquainted with the works of Percier and Fontaine?—Perfectly.

1292. Do not you think that they have contributed very much to spread just ideas of taste in design?—Very considerably; Europe is greatly indebted to those artists.

1293. Does not that afford a proof of what people in quest of just views and capable of carrying them into execution may do towards reforming the art of their day?—Clearly; Percier and Fontaine have been highly useful to the manufacturing arts of their country and elsewhere.

1294. Has not ornamental pottery made some progress in this country?—Some, but very little, on account of their not employing persons who have a good idea and knowledge of elegant form and beautiful proportions.

1295. But is it not one of those branches of art which is most susceptible of improvement, and in which the advantage would be most perceptible if that improvement took place?—It would be very greatly so.

1296. Are the forms in foreign or in British china most accurately drawn?—Foreign; some of the French and German are beautifully designed in form and proportion. In this country works of the best forms are those copied from foreign articles.

1297. Then you would of course apply your more general observation to these particular branches of manufacture, and state it is very desirable for the persons who design for china to be better instructed than they are?—Exactly, and thence obtaining better taste.

1298. What do you consider to be the effect of the brick duty, as far as art in architecture is concerned; the limiting the bricks to a particular size and a particular form?—As the material of which brick and tile is composed is capable of receiving an impressment of mind upon it, and to great extent and variety, I have no doubt that permission to make them in any form would be a great benefit to architectural beauty.

1299. Is it not the case that in Lombardy brick is introduced in combination very nearly as beautiful as any thing that can be made of stone?—I have known it so. There is much of beautiful form and useful work that might be executed if the manufacturers of bricks were allowed to make them of any form they chose; but for general building I am not aware of any forms so good as those now in general use.

1300. And is it not the case that in all countries where brick is used in great quantities except in England, that modification of form does exist?—I believe it has been so from very early times.

1301. Does it not result from that that the limitations to which brick-making is subject in England are a great impediment in the way of development of that description of art?—Clearly.

1302. If it were not for the high duty on plate-glass and the duties paid on glass generally, would not glass have been made a material to exercise art upon more extensively than it has been?—I think it would; one of the great preventions in introducing coloured glass particularly, is, as I am told by the manufacturers, that they may not melt less than a certain large quantity of any one colour; therefore, if it is for small articles that they want it, or for one small article, they are perfectly prevented from using it at all.

1303. And has not the window-tax also, in limiting the number of apertures and restricting their size, had an exceedingly injurious effect?—Exceedingly; and in the proportion and the beauty of buildings altogether, architects find very great difficulty in adapting size and proportions, so as not to infringe upon the limitations prescribed, perhaps when they want very different quantities.

1304. So that in fact a great deal of the poverty and monotony of our buildings in London may be traced to that source?—Yes, a great deal of it.

1305. Is

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1305. Is sufficient intelligence in art exhibited in such works as furniture in this country?—I think not, unless designed by the architect himself. If he will not give his attention to it, the taste of the furniture is not good in this country, or not so good as it might be.

1306–7. The taste of the manufacturing designer is too unconstrained by the general principles of art?—I think so.

1308. But does it not fall within the province of the architect to give that attention?—Not always; there are a great number of employers of an architect who would rather go into a cabinet-maker's shop or elsewhere and buy articles than direct him to design them.

1309. But did not those people we have alluded to, Percier and Fontaine, turn their attention very much to interior decoration as well as to exterior and higher branches of art?—They did to both, and such has been the practice in England also.

1310. But in the furniture of houses generally in London, which are left to the mere upholsterer to furnish, is there not a want of knowledge of body and of form and combination and of accuracy?—I think there is, indeed I know there is a great want of clever designers in that as in other departments.

1311. And in fact, as you have already stated, there is a want of closer connexion between art and manufacture than exists?—Certainly there is.

1312. Is there not now, for instance, in the arrangement of drapery, a great want of taste prevailing in this country?—I think there is generally; but we have some well qualified on the subject of drapery.

1313. What is your opinion of the degree of skill that exists in this country in the arrangement of drapery, as contrasted with that of the Continent?—I have seen drapery done by people in England vastly superior to any thing I have seen on the Continent; I think we have often been more successful.

1314. But what should you say generally of the manufacturing artist in drapery?—I should say that we have but few eminent artists who generally design it, but the principal of the house and his local assistants.

1315. In fact, then, it would be only just to the artist that he should have better instruction given him than he has at present?—Clearly.

1316. But do you consider good taste is as generally prevalent in this country as it is abroad?—Certainly not; I think we are very far behind the French in some instances, I am speaking of the manufacturing arts, and not as relating to the higher departments of art.

1317. And therefore you do not attribute the want of taste to the want of talent in any degree, because it exists, where properly encouraged, in the higher branches of art, but you attribute it to a want of instruction generally?—Decidedly; I am satisfied there is innate talent enough in the country to supply all its wants in art.

1318. Do you consider that some knowledge of the principles of art ought to belong to those people who have the superintendence of public works?—Certainly.

1319. Have you any other observation to make to the Committee?—None, except this, that I was present when Mr. Skene gave his evidence, and I agree generally in what he stated.

Lunæ, 24° die Augusti, 1835.

WILLIAM EWART, ESQUIRE,

IN THE CHAIR.

Messrs. *Philip Barnes* and *Robert Barnes*, called in; and Examined.

Messrs. *Philip Barnes* and *Robert Barnes*.

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1320. To Mr. *P. Barnes*.]—WHAT are you?—An architect, also Fellow of the Linnæan Society.

1321. Where do you reside?—At Norwich.

1322. You are connected with an institution for the promotion of the knowledge of arts among the manufacturers of Norwich, are you not?—I am connected with the Norwich Society of Artists for promoting the knowledge of Drawing, and have been for the last 25 years.

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1323. Will you state how that institution is connected with the manufactures?—The institution itself is not connected with the manufactures, but since the establishment of an academy of art, which is attached to the Norwich Society of Artists, it might be so connected. The institution itself was established in 1803 as a society, and first had a public exhibition of the works of art by the members and their pupils in 1805; which public exhibition continued annually till 1833, when by the death of some of its members, and the withdrawing of others to the Metropolis, and the want of patronage and other causes, over which we had no control, we were obliged to suspend the exhibition for the present from that period. The society itself is the oldest provincial society out of London; and I believe it is the only one that has maintained itself, after struggling with great difficulties. It is supported principally by the exertions of the members themselves.

1324. How long has the other establishment existed?—That has existed about five years: that was in consequence of the corporation of Norwich presenting the Society of Artists with the sum of 100*l.* to purchase a collection of casts, with a view to have it as an open and more public establishment. The society has extended the number of casts, and expended other monies besides that given by the corporation to establish this academy; but the expense of conducting the academy is now sustained by the pupils themselves, at a rate of pretty near 4*l.* a year each.

1325. How many pupils are there?—There are not more than six pupils at this present time, and those are adults; there are no masters.

1326. What instruction is given to them?—The artists themselves attend and give mutual instruction. There are no regular masters.

1327. And are these artists simply artists, or are they artists connected with manufactures?—They are artists only, and drawing masters.

1328. Then what effect has that on the manufactures of Norwich?—Why, at present I am not enabled to say what effect it has had; but it would have an effect if it could be thrown open and made a free school.

1329. Has this institution ever had an effect on the manufactures of Norwich since it was established?—I think in this respect it has, that there are scholars who go now to this place who had not the opportunity before, and who are supported by occasional assistance of friends; for instance, Mr. Walker, a gunsmith, pays for a boy, who otherwise could not attend to take instruction, and a very talented youth he is.

1330. Do any persons who pursue manufactures attend this institution; for instance, do any weavers?—I am not aware of any at this moment.

1331. Then this institution has very little connexion with manufactures?—Very little at present.

1332. Was it established with the view of aiding art among manufacturers?—It was established with the view of extending art generally in Norwich.

1333. But not generally with a view to manufactures?—Not altogether; but we were in hopes it would lead to that.

1334. Would it be of service to the manufacturers there to extend such institutions?—Most assuredly; and Mr. Barwell, the secretary, has been most anxious to extend it for that purpose.

1335. Do you consider that you speak the opinion of the manufacturers themselves, when you say that?—I have no doubt of it.

1336. Do you think the workmen would like to have such institutions?—I am sure of that; and as a proof of it I have a letter sent me by our secretary, Mr. Barwell, from one of the drawers of patterns connected with shawls.

1337. State the substance of what he says in that letter?—He says that his income is too limited to allow of becoming a member of the Drawing Academy, established in this city; and that consequently he is obliged to depend upon his own talent for the production of designs suitable for the manufacturers; that if he could avail himself of attending the institution or the academy, he has no doubt that it would be of considerable service to him in promoting his taste and knowledge in the fine arts and in the art of design; and that he speaks the sentiments of the pattern-drawers generally, who are similarly circumstanced to himself.

1338. Have you any open galleries in Norwich for the exhibition of works of art of ancient masters, or of casts from the antique?—None besides this academy.

1339. What does this academy contain?—General casts from the antique.

1340. You have some casts then of the antique?—Oh yes, a great number.

1341. You

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1341. You have a good collection of casts, have you?—Yes, it is considered to be so.

1342. What do they consist of?—Statues and vases.

1343. Now is that collection open to all the public?—No, it is not.

1344. Is this gallery of casts open to the public?—On application to the secretary persons may see it.

1345. But nobody can walk in at once?—Oh, no; certainly not.

1346. Do not you think it would be better to allow the public to walk in under proper superintendence?—Most unquestionably, and that is an object which the society would be anxious to obtain. The society would open it to the public if it were not for the expense of the superintendence.

1347. Have you any other open exhibition in Norwich besides this?—None, only the annual exhibition.

1348. Do you think good has resulted from this exhibition as far as it has gone?—Undoubtedly, to a very great extent; the artist has improved, and the taste of the pupil also.

EXTRACT from Mr. *Roberts'* Letter (of the firm of Wilmot & Roberts of Birmingham); August 3, 1835.

"I have indeed always felt much interest about the Norwich Society of Arts, and great reason have I to do so, for I have ever considered that your society, in better days, gave an impulse to the provincial institutions, and exhibited to the country a display of local talent which left every other similar attempt far behind."

1349. What hours of the day is the gallery open where the casts are?—It is not open at all except on application.

1350. Then can you give any idea of the number of persons who visit this gallery of casts from the antique?—No.

1351. Do you think there are many persons in a day?—Oh no; very few indeed, because we cannot allow of any person being there to attend. If we could have a person in attendance, I have no doubt a great number would visit it.

1352. And there is not a person in attendance because the society cannot afford it?—They cannot afford it.

1353. Do you think that the institution of schools and places of instruction in art would be a great advantage to the manufacturing population of Norwich?—Undoubtedly.

1354. Do you think also that the opening of galleries where they might see the most beautiful works of art, and opening libraries where probably such works might also be exhibited, together with books, would not also be a very great advantage to the manufacturers?—It would, decidedly.

1355. It would call into life a taste for art which is either dormant or does not exist at present?—Yes, and particularly in Norwich, where I think there is a general taste for literature; and that the lower orders of society there would be very much improved in a very short period of time.

1356. Do not you think that the institution of such places of instruction and of such galleries of art would have the effect not only of improving manufactures, but the moral and social conditions of people?—Unquestionably it would to a very great degree.

1357. What branches of manufactures in Norwich will be principally benefited by such institutions?—The fancy fabrics of Norwich, the shawl and silk dresses, and fancy goods generally.

1358. Are we inferior or superior to the French in such fancy patterns now?—The patterns themselves are inferior to the French, decidedly; but I have always understood that the workmanship is far superior.

1359. How do you account for this inferiority on the part of the manufacturers of Norwich to the French in patterns?—From the want of establishments of the kind where they could be properly taught.

1360. Then you think the French are superior?—Undoubtedly, they have better opportunities of learning.

1361. Have you ever known the French system of instruction?—I have been on the Continent, I have visited the Continent several times, and I find they have large establishments there that are open to the public with very trifling expense.

1362. You have not been in France with the especial view of turning your attention to the subject of instruction in art, have you?—No.

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1363. But you have been in some parts of the Continent?—I have visited it merely for pleasure.

1364. But you are not a member of one of the academies on the Continent?—Of Bruges, I am.

1365. Will you state what is the nature of the instruction given in that academy?—The academy at Bruges has different departments in art. There are, I understand, three masters for the first degrees of figure, another for life, one for architecture, one for sculpture and one for painting. The academy is supported by subscriptions, partly from Government, and partly from the town and governors themselves, who have the power to send pupils and recommend students.

1366. Do the students pay anything?—Nothing I believe except a fee of a franc to the servants.

1367. Is there any examination as to capacity of the students for art before they are admitted?—None.

1368. Then is any body allowed, whether he has talent for art or not, to continue to profit by the establishment?—Yes.

1369. Would he not be sent away if he were found incapable?—No, I believe not; my son can tell; he was there.

1370. To Mr. *R. Barnes.*]—Do you happen to know whether that is the case, that they will be sent away if they are found incapable?—They never allow them to go into the higher branches, they do into the lower.

1371. To Mr. *P. Barnes.*]—Are the young men in this school instructed with a view to proficiency in designs connected with manufactures?—I should presume the art generally; the continental feeling is such, that almost every town there has an establishment.

1372. Then this school is generally open, is it?—Yes.

1373. And does it extend a knowledge of the art generally throughout the population of Bruges, do you think?—There are six or seven hundred students, and the population of the town is little more than 20,000.

1374. Do these young men enter the school with the view of becoming manufacturing artists, as well as becoming artists only?—I have no doubt of it.

1375. And have you the means of knowing whether this institution has had a good effect on the manufactures of Bruges?—I have always understood it has.

1376. Do you suppose that such an institution must have an effect upon the capabilities of every manufacturer whose trade is at all connected with design or pattern?—I have no doubt it would be of great advantage.

1377. Do you know at what time the students are instructed in these institutions?—In the evening; every evening in the week excepting Sunday.

1378. What is the reason that they are not taught in the day?—Because the greater portion of them are the poorer class of society, and they have a better opportunity of attending in the evening after the labours of the day.

1379. And do they attend to the number of six or seven hundred, do you suppose, in the evening?—I believe so.

1380. Is the establishment large enough for that?—The establishment is quite large enough for that; it is an immense building.

1381. To Mr. *R. Barnes.*]—Do they instruct them in perspective?—Yes.

1382. Is any instruction given them in the application of art to the peculiar manufacture which they are themselves pursuing; for instance, if a young man is a caster of metal, is instruction given him in that particular branch?—No; I believe not.

1383. Then it is in drawing generally?—They go in and go through the regular course, without application to any particular subject.

1384. Are there any prizes given to the students?—Yes.

1385. Who decides on the capabilities of the students?—The master and the governors between them, I believe.

1386. Are the prizes distributed publicly?—Yes.

1387. Is it marked by any peculiar solemnity?—Yes.

1388. What is that?—There is a general procession through the town.

1389. Are the students allowed to dispose of their prize pictures afterwards?—Yes, they are.

1390. The prizes are not only gained by pictures, but also by modelling and various other means, architecture and so on?—There are prizes given in every department.

1391. To Mr. *P. Barnes.*]—Are there such institutions at other places on the Continent

Continent besides Bruges?—Yes; there are at Ecclo, Ghent, Amsterdam, Rotterdam and Haarlem.

1392. Do you think that has infused a considerable knowledge of the arts among the population in those places?—Undoubtedly.

1393. And you consider that an artizan, taken from the population of such towns where such institutions exist, is a better artist than an artizan would be in a town of a similar size in England?—There is no doubt of it.

1394. But you are not so well acquainted with the other towns in Holland, or the Netherlands, as with Bruges?—No, I am not. I have visited an establishment at Amsterdam called the Felix de Meritis, which has also a department for music and philosophical instruments, and it is a very fine establishment.

1395. Have you any public library at Norwich open to all persons?—We have a public library there; but it is on a subscription of a guinea a year. There is none open to the public free.

1396. Would it not be a very great advantage to the manufacturing population, and would it not improve taste in art, to a certain extent, if libraries were open to them?—Yes; this guinea-a-year subscription one is, of course, above the means of most of the artizans, because they are obliged to purchase a ticket, of, I believe, three guineas in the first instance, besides the subscription.

1397. In the towns which you have alluded to in Holland and the Netherlands, are there not public libraries more generally open?—They are quite free, generally, I believe; I am not speaking of all; at Bruges there is a very fine public library.

1398. Is the establishment that you mention at Bruges connected with any academy of art, or schools for higher classes of art?—The academy itself takes the different grades in art.

1399. To Mr. *R. Barnes.*]—Does the academy range from the highest degree down to the lowest?—Yes.

1400. There is nothing like a college of artists there?—It is an establishment merely for the purpose of teaching.

1401. To Mr. *P. Barnes.*]—What is the population of Norwich?—Near 70,000.

1402. What is that of Bruges?—Between 20,000 and 30,000.

1403. What number of scholars are instructed in art in Norwich?—There are about six at the academy, the rest are taught by private masters, and that in a very confined way.

1404. How many students are there instructed publicly at Bruges?—Between 600 and 700.

1405. Have you ever turned your attention to the extension of this establishment at Norwich, by which it might be made available to public use?—I have from the first, with Mr. Barwell, been most anxious that it should be thrown open to the public in the most extended manner possible.

1406. Have you any suggestion to offer as to any means of making it more publicly useful?—If a small pecuniary assistance was afforded by Government, and it could have a correspondence with a central board, it would have the effect of giving those who are desirous and who are connected with manufactures a facility to improve themselves in art, to the great advantage of the fabrics that are manufactured in the city of Norwich.

1407. What do you think would be the benefit of a central board?—I think it would be of considerable advantage to be in constant correspondence with the provincial establishments that might be made in the country; so that if pattern-drawers produced a good pattern they might be protected for a certain period of time under the control or management of the central board.

1408. Do you mean for the protection of inventions and designs?—Exactly so.

1409. Would you have any central institution for educating persons to be masters, and to instruct those in the distant parts of the country?—I think probably that if institutions in the various towns were established, they might produce artists themselves quite competent; but that they should obtain a testimonial from the central board; that they should be made to pass an examination at the central board; if not, then the central board ought to supply proper masters to the provincial establishments.

1410. Do you think central establishments would be of any use in serving as a kind of depôt for every thing that is new in designs and manufactures?—No doubt.

1411. And for keeping up a constant correspondence, not only with the manufacturing

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manufacturing districts of the country, but also with foreign countries?—Unquestionably.

1412. You just touched on another branch, protection given to works of design; have you any thing further to say on that subject?—If a pattern-drawer produces a good pattern, which the public would readily purchase, he ought to be protected for a certain time in the advantage of that pattern, because it would otherwise be pirated, and he would not be sufficiently rewarded for the talent he has displayed in the production of that pattern; I hold it to be necessary that all artists should be rewarded for their talent as much as possible, with a view to the public good.

1413. Have you any botanical garden at Norwich?—We have not.

1414. Is it not most desirable to connect botanical gardens, if possible, with institutions for the instruction of the manufacturing population in art?—Undoubtedly. As a proof of that, we have these last three or four years had an establishment of a Horticultural Society, which has greatly improved the habits of the cottagers of the country, and they are now extending them throughout almost every town in Norfolk, viz. Yarmouth, Holt, Aylsham, Dereham and Lynn. A botanical garden would have a greater effect with regard to arts on the manufacturer undoubtedly, because he would be enabled to draw the flowers from the flower itself.

1415. Would it not be very desirable, wherever practicable, to connect such places of instruction with botanical gardens?—If it can possibly be so, it would undoubtedly.

1416. And might it not be easily done without detriment to the botanic gardens?—I should think it might.

1417. And is it not also generally desirable to connect such places of instruction in art with other institutions immediately or indirectly connected with art; such, for instance, as schools of anatomy, schools connected with mathematics, and so on?—The more you can connect them with each other the better.

1418. The greater light they throw on each other?—Undoubtedly.

1419. And might not it be very practicable, where institutions such as those we are speaking of, were established in towns where there are large populations to connect them with such institutions, might it not be for the mutual interests of the different institutions to be so connected?—Undoubtedly.

1420. Is any chemical instruction in dyeing and the combination of colours given in Norwich?—We have no school for that, I believe; but we have some first-rate dyers in Norwich.

1421. Would it not be desirable to have such instruction?—It would be very desirable.

1422. Has dying much improved in Norwich of late years?—I should think so.

1423. To what do you attribute that improvement?—To the competition with the foreign market, and the more general diffusion of knowledge among those classes.

1424. Have you been induced to draw a comparison between the external architecture of foreign houses and those of this country?—I have; the foreign artist abroad has the opportunity of designing the elevation as he pleases, not being confined to the width of his windows by any tax upon them, which in England is very objectionable.

1425. And with regard to the shape prescribed for bricks in England (the measurement of bricks), is that found to be at all onerous?—I think the buildings generally in brick, countries would be improved if the duty was taken off the ornamental brick, or made equal.

1426. Proportionate to the quantity of material used in them, do you mean?—No; I should say, that if you wanted to have an ornamental brick, like this inkstand for instance, you should make one precisely the same as a common brick; now you are confined to a certain size.

1427. You think the duties on brick operate prejudicially in sustaining art?—I think, if the duty was taken off altogether, it would be a great advantage to art generally; the interior decoration of our rooms, as regards paper and other ornaments, is very far inferior to that of the French, for the want of art being more generally diffused among the artizans in that department.

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Veneris, 28° die Augusti, 1835.

WILLIAM EWART, ESQUIRE, IN THE CHAIR.

Charles Robert Cockerell, Esquire, called in; and Examined.

1428. YOU are architect to the Bank of England?—Yes.

1429. And an associate of the Royal Academy?—Yes.

1430. Your attention of course has been turned to the decorative part of architecture?—Yes.

1431. Have you experienced any difficulty in procuring assistants in that part?—Yes, very great difficulty; in our business we have occasion chiefly for ornamental plasterers, carvers in wood, marble, stone, casters in iron, moulders of iron, chasers in bronze, and ornamental painters, &c. &c. I find that we have had a very great dearth of late years (at least 50 years or more) of artists to fulfil those duties. I believe that to have arisen from a change of taste in a great measure since the beginning of the last century, especially the time of George II. and Louis XV. and the introduction of what was assumed to be the Greek and antique taste under Adams the architect, Chambers and others, when cast-work was very much introduced into cielings and walls, cast-work in putty decorations on wood instead of carving on wood, which abounded under Grinlin Gibbon, and under the architects of Queen Anne's time. I apprehend that the system of cast-work and mechanical process has displaced the florid and more elaborate style of our ornamental work; and I believe that the attempt to supersede the work of the mind and hand by mechanical process for the sake of economy, will always have the effect of degrading and ultimately ruining art. Formerly, for instance, it required a long apprenticeship to acquire the system of ornamental plaster work, done by the hand in cielings: there were artists that were brought up from childhood and passed their lives in that occupation; there is not one now to be found in this country. A few of those exist in Ireland still; but during my knowledge of practice, which has been for upwards of 25 years, I may say that we have had but two or three modellers at the same time, who have been capable of executing well the matrix from which these ornamental cast-works are done; a Mr. Bernasconi till 1820, Mr. Rogers, and more recently Mr. Nicol; and the consequence of the paucity of hands, the delay and the difficulty has been, that architects have been deterred from the introduction of ornamental works of this description. Within the last few years, however, an improvement has taken place, from more universal acquaintance with fine examples on the Continent, the prosperity of the times, great competition and other causes. Some years ago we had an ornamental painter, Mr. Dixon, but that art has ceased and is altogether lost.

1432. That would not be attributable to the same cause you stated before, which was the preference of casting instead of working?—No; but it is attributable in great measure to the introduction of mechanical art, generally termed polygraphic, as for instance, all kinds of papering, carried on in France (to which country the observation may also apply) still farther, in the execution of historical subjects, landscapes, &c. in papering, which are well known.

1433. Is it assignable to any other cause particularly?—I think also to the absence of taste during our exclusion from the Continent, and in the absence of encouragement of that class of art.

1434. Do you suppose that the absence of taste proceeds from a want of artists?—Not from a deficiency of talent if properly cultivated; but I presume that the want of artists proceeds rather from the absence of taste and encouragement in employers, who have not had the means of forming a good taste, and who have not had the wealth, during the last half century of taxation, war and dear living, to encourage those secondary arts which are expensive in this country.

1435. You have stated in the course of your evidence that there have been in your acquaintance, at the same time, two or three artists only who can execute from original designs in plastering?—Only two or three artists who could execute

well from original designs; in that art there has not been, as I have already stated, great employment for many hands, so little has been the demand.

1436. Do those artists, in consequence of the smallness of their number, charge a higher price than they would if there was a greater number of artists?—Yes, they do.

1437. Do you think if there was a greater number of artists, and in consequence the price of that species of art was diminished, there would be a greater demand for it?—Unquestionably a greater encouragement of such a class of artists.

1438. And a corresponding improvement in taste, and better appreciation of works of art?—Yes, the benefit would of course be mutual. I apprehend that there are two sorts of encouragement; the one, abundance of employment, the other, such an estimation of the art in the public as would stimulate ambition, and urge the artist by the cultivation of his art to seek honours in the higher departments. In this commercial country wealth is apt to be considered the supreme desideratum, and if the artist unites calculation and conduct in business with excellence of talent, he at length becomes a tradesman, seeing no prospect of other reward. Of course this observation applies especially to arts connected with trade and manual labour.

1439. Have you had occasion to consider art as applied to manufactures?—Yes; I have considered it so far as relates to architectural decoration, that is to say, in bronze, steel, plate, and iron, papering and occasionally china, &c. and whatever manufactures depend materially on design for their effect. Having resided a good deal abroad, I have been piqued as an Englishman at seeing the great superiority of foreigners in that respect. I have visited the manufactories of this country with a view to this question, and I have exceedingly lamented the want of instruction I found in those manufactories, but I have much more deplored the indifference shown by Government on a subject which materially concerns the honour and character of England as respects arts, and which is of paramount commercial and national importance in a manufacturing country, where the cultivation of taste only is wanting to give us the superiority over the world.

1440. Did you turn your attention to any particular species of manufactory, or did you take the whole range?—Yes, especially those employed in architecture, as, for instance, brass works, applying to balustrades, furniture of doors, grates, stoves, plate, cutlery, and similar works done at Birmingham, which an architect is often called upon to direct. I have found that, from the ignorance of the true principles of design, there is a constant waste of capital in the capricious and random endeavour to catch the public taste; I have freely commented upon this deficiency, and have generally found it confessed. The manufacturers are not sufficiently impressed with the necessity of a higher culture of design; they generally dabble themselves, and put things together from books; they purchase books of design with avidity, and I have known them buy up the stock of a bookseller to secure the exclusive advantage of a rare publication of patterns. Some years ago his Grace the Duke of Northumberland had the liberality to lay out a large sum in his house at Charing-cross on manufactures wholly English, and of unusual magnificence. I followed the execution of these in various manufactories, and found them always at a loss for design and models well understood, and confessing, according to their own words, the deficiency of the master hand.

1441. Were those works executed after the taste of any particular æra?—Generally what may be called Grecian.

1442. In what respect do you consider the productions of foreigners, in articles of porcelain, superior to those produced in this country?—Unquestionably in the forms and in the design of ornament, and the adjustment of colours.

1443. Do you mean the colours are better prepared, and that there is a greater degree of brilliancy in them?—I should say the harmony of colours, as applied by artists in the painting of flowers, history or landscape, &c.

1444. In which of those do you think foreigners are superior to the English, I mean as regards porcelain?—Flower-painting and ornamental scroll-work, and the blending of the gold with the proper colours.

1445. How far do you conceive that is connected with the art of design?—First of all, I conceive the beauty of the porcelain must depend upon its form, and its contrivance; for instance, the works from China, in which we see animals introduced, not only with a view to ornament, but for real utility, as handles, feet, &c., as also in the antique vessels in pottery or bronze, we constantly observe an admirable adjustment of such useful and ornamental portions of the work, full of taste

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taste and meaning; and, secondly, the beauty of porcelain must depend upon the arrangement of the design, and colours painted upon it.

1446. Did you pay any attention to the different qualities manufactured abroad; for instance, at Paris, at the manufacture of Sevres, and those made at the common manufactories in the neighbourhood of Paris, for common use?—Upon the quality of the material, I cannot pretend to answer; I merely speak as to the art or design employed on the work. I beg to mention upon that subject, that my friend Mr. Isabey, the miniature painter to Napoleon, was occasionally employed at Sevres; his talent, which is the first in France, had been employed by the Government in historical painting, and portrait and ornamental painting in the china works got up at Sevres. I may add on this subject, that amongst a large acquaintance I made at Rome of French artists brought up at the Academy, (of whom I think there are from two or three painters sent annally from Paris to Rome to study, and of those men I think I have known about 15,) there are not above three or four who have become celebrated, the rest being very accomplished men, but scattered throughout the provinces of France, and transferring all their knowledge to the different manufactories and provincial schools. I have seldom heard of these men, except that they were living in their own provinces, without much fame in the upper branches, but their skill honourably employed in assisting various manufactures.

1447. Are you acquainted with the mode in which the persons sent from France to Rome to study are supported; if at the expense of Government?—Yes, of Government. The students of the Academy at Rome live and study together in the different museums at Rome; the Academy was instituted in the reign of Louis XIV., with every possible advantage which students can have; indeed, too many; and all the evils of the academic system have been experienced there for many years, and have been lately avowed publicly by Monsieur Vernet, their president. The evils of too close an adherence to the academic system are as great nearly as the total neglect of it in a country.

1448. With regard to the art employed on porcelain not under the protection of Government, what is its comparative merit with that of England; you have mentioned Sevres; now draw the distinction between that establishment, and those which depend on popular support?—I should say, that the latter follow the higher example of those schools instituted by Government.

1449. Do you mean to say, that they have as much excellence in manufacturing porcelain?—Not the same excellence, but they imitate more or less the higher manufacture.

1450. Is the taste exhibited by such persons, depending upon popular support, equal or superior to that exhibited in England in the same branch of manufacture?—I think it is superior; they look to higher sources of design on the Continent generally.

1451. You do not think there is a sufficient diffusion of talent among artizans in general in this country?—There is an abundance of talent, but a want of opportunity of obtaining more correct knowledge of design.

1452. There are not the means of diffusing them among those persons who are capable of such instruction, if afforded them?—There are not the proper means in this country.

1453. Have you considered the relative state of arts, as applied to manufactures, as compared with England and the Continent?—I have.

1454–5. What is the result of your inquiries upon that subject?—I apprehend that the object of legislation on this subject must be the multiplication of industry and commerce, as well as to give splendour and do honour to the country. The Governments of the Continent have been always better and more systematically directed to arts and manufactures than by our own scattered endeavours, especially in the higher departments, by establishment of professors of archæology furnishing the learning necessary, academies providing accomplished hands, by premiums on manufactures, direction of some of them, by exhibitions of art of all ages gratuitously, thus diffusing taste through every class of society from the manufacturer to the purchaser. The result on my mind has been, a conviction of the necessity of such means in this country as they have on the Continent, which, superadded to the capital and industry of this country, would give us the superiority over every other in arts and manufactures.

1456. Do you consider the arts are more in general diffused among the classes

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of artizans on the Continent?—Unquestionably, inasmuch as the leisure of the artizans in most of the cities, of France especially, is passed in the palaces and gardens of the king, where they have beautiful works before their eyes, in architecture, sculpture and painting; a paternal and enlightened government long ago (near 300 years) provided these elegant recreations for the people, instead of passing their holidays, as our artizans do, in the pot-house. In various manufacturing cities which I have seen very lately, as Sheffield, Birmingham, Glasgow, &c., I have been struck with the degrading comparison.

1457. You are very favourable then to the opening of public galleries containing works of art of all descriptions, and the free admission of the public to those galleries?—By all means, especially as connecting their amusements with a more refined recreation, as well as affording them the gratifications of curiosity or study.

1458. I suppose your remarks would more especially apply to manufacturing towns, where generally the habits of the people require much recreation, and where their occupation is also connected in some degree with the arts?—Certainly, and every man must lament, and especially an artist, the absence of those places, such as public gardens and parks, with sculpture exhibited in the open air and in galleries, museums of natural history, botanical gardens, &c. Many of the noblemen's houses within reach of our manufacturing towns contain such museums and collections as would have conferred the utmost advantage upon them if so bestowed. I beg to mention as an instance of this kind of liberality, that Sir Robert Lawley gave a gallery of casts some years ago to Birmingham, which has formed the foundation of a collection there.

1459. Can you mention any instance in the provinces where an artist educated in the higher branches has devoted himself to the more simple process of introducing art among the manufactures?—Yes; I have already cited Mons. Isabey and the French academicians; in this country I know that Mr. Briggens, a very able artist, established himself at Birmingham, but though fully qualified, he did not succeed, and left the place about ten years ago. This I must attribute to want of discrimination in the public taste as well as in manufacturers, since they would have paid for design if worth their while. However, all experience both in ancient and modern times shows, that if able artists confer advantages on manufactures, they in their turn have often produced great artists.

1460. Do we draw the inference from that, that it is desirable even among artizans to encourage the knowledge of correct principles of design, to encourage among the lowest class all that portion of art founded upon principles which may be called almost the science of art; for instance, the knowledge of correct drawing, proportion, perspective or any of those things; would such instruction be or not a benefit to the mind of artizans in so far as they are artists?—I do not think such knowledge compatible with the occupations of artizans, and the encouragements to it would mislead them, and interfere with their proper callings, and right division of labour, in which excellence already requires all their ability. There is a wide distinction between art and fine art; in the latter the knowledge of artizans whose bread is earned in laborious work, must be always very limited, compared with those who have an original genius for it, and have been brought up in the highest schools, and with the best opportunities of instruction. This knowledge is a science of itself, and requires a life to attain. There is every respect among artizans towards men of superior knowledge, they bow to them, and follow them implicitly if they have reputation for merit; but I apprehend that any attempt at a general diffusion of the higher principles would be futile. Those principles may be in a measure imbibed by the constant view of fine objects, and the encouragement of men brought up in higher schools to instruct in the lower branches of arts and manufactures, would be, in my humble opinion, the best course.

1461. Do you consider the ancients dwelt much upon the importance of the connexion between manufactures and arts?—I should say the evidence of all history, especially Grecian, confirms the fact of their solicitude on that subject. We know that a stranger who established a new manufacture in Athens, obtained the rights of a citizen. Athens and Ægina were the great manufactories of Greece in all works connected with fine arts; some of the most illustrious philosophers and statesmen were sons of manufacturers, or some way connected with fine arts. The artists of Ægina had more commissions in all parts of Greece than any other nation. The manufacture of bronzes, especially candelabra, is celebrated by Pliny. Herodotus

Herodotus informs us that they had a protecting duty on fictile vases, and there were peculiar laws for the protection of manufactories and the restraining the artists from emigration. Great artists arose from the manufacturing establishments; and again, it is apparent from all their works that those artists who had failed in the higher branches applied themselves to the lower ones, and we have admirable works of a minute and minor kind comparatively, such as vases and bronzes, armour and medals, which unquestionably are executed by men who have worked upon a much larger scale, and attempted very much higher things.

1462. Have you designed for manufacturers?—I have had occasion to design for various branches of manufacture; and I have found that a very particular devotion of study is requisite in the application of art to the particular material and mode of workmanship, in every branch of manufacture, and that in fact each requires a practised artist.

1463. I understand that you have designed for manufacturers?—Yes, I have designed for Rundell & Bridge, at the time they employed in the same occupation Mr. Flaxman, Mr. Stodhart, Mr. Bailey and Mr. Howard; and one of those gentlemen specially attached to the concern received a salary of 500*l.* a year, and a house to live in, and a portion of his own time to employ in his art, not in their interest, and apprentices who working under him were separately charged against the house; and I had occasion to know that they spent in designs alone 1,000*l.* a year and upwards, and quite as much more in the higher order of chasing, and the execution of ornamental works. In illustration of the magnificent and enthusiastic patronage of manufacturers, and the honour and advantage they confer upon their country, I beg leave to mention an anecdote of the late Mr. Wedgwood, related to me by Mr. Cumberland, of Bristol, who wrote a pamphlet in 1792, recommending a national gallery of sculpture. casts, &c.; in aid of which Mr. Wedgwood made a tender of 1,000*l.* I beg further to say, that I have found Wedgwood's works esteemed in all parts of Europe, and placed in the most precious collections of this description of works.

1464. As such designer, have you had any opportunity of observing that any want of protection exists for the invention of the artist?—Yes, in a great many instances; and to my knowledge that house in particular (Rundle & Bridge) has suffered most materially from piracy.

1465. Do you mean to say, that when they have paid an artist a high price for a beautiful design, that persons in the same trade have copied the design and offered it at a less price?—Yes, that has been the case in every business of this description.

1466. And do you consider that upon that account there has not been so much encouragement in the employment and the payment of a high price to that particular class of artists?—Decidedly so; because, say they, we pay you to design for other people. That is especially the case in paper and in furniture, and in floor-cloth manufacture. It was but yesterday I had occasion to see a very eminent floor-cloth manufacturer, and who stated to me that his designs were copied within a few weeks after he had issued them, by a cheap house in Bristol. These gentlemen express their obligations for the designs, but they say, "we cannot continue to employ you, because we have no protection for the designs after they are made."

1467. Have you ever turned your attention to the mode of protection necessary?—I have not particularly done so, but a cheap and summary remedy to the evil is necessary. I understand that wherever questions of patent have come before the Court of King's Bench, there has been a disposition always on the part of the jury to favour the liberal construction of the case, as they conceive it, and to oppose exclusive rights; so that a person in defending his patent is very much discouraged.

1468. Would it be any advantage if the protection were afforded in these cases at a shorter period than patents are generally taken out for, which is for seven or fourteen years; do you not consider that a limitation would be advantageous?—Various terms adopted for various materials.

1469. And that the degree of protection should vary with the necessities of the case?—Yes, from the nature of the material and the fluctuation of fashion, which changes in paper, floor-cloth, printed and painted wares more readily than in silver, bronze and other expensive materials.

1470. Is there any protection at present for printed papers?—I believe not; I judge from the dilemma the manufacturers are always in, between their solici-

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tude to show their inventions to purchasers, and yet to conceal them from manufacturers; in receiving a customer, therefore, they have first to discern whether he is a purchaser or a pirate.

1471. Would three months, which are now allowed to the maker for the protection of designs in printed cottons, be sufficient for the designer of paper?—I should think three months rather a short period.

1472. Have you ever considered whether there should be any system of registration employed for designs?—I conceive that to be a very certain mode in some sorts of manufacture, and a summary legislative power by a jury of certain persons well acquainted with the art; for such particular acquaintance is necessary to recognize and distinguish the principle of a design through any attempted variation of the parts; and this is a point of some difficulty, and has been found so in patents.

1473. Do you not think an injunction in the Court of Chancery is the best means, if you can obtain it at once?—Yes, if at once, but hitherto it is an expensive and tedious mode, and the object is often lost during the process.

1474. Have you had occasion as an architect to turn your attention to the effect of the Excise law which regulates the shape of bricks?—Yes.

1475. Can you state from your own knowledge what is the difference of Excise charge?—I have long known that the Excise levy a great increase of duty upon bricks moulded out of the common way, being 5*s.* 6*d.* on common bricks and 9*s.* per 1,000 on bricks exceeding the common size in any dimension, so as to dissuade architects from the use of moulded bricks in their works. The celebrated Sir Henry Wotton complains of the want of knowledge in this respect in England, observing that there was generally too much of the material of bricks in the makers.

1476. As an architect, do you think any person who was desired to form a stack of chimneys with moulded bricks, according to the beautiful models we have in the old buildings, that he would be dissuaded from adopting such material from the effect of the Excise charge solely?—Not solely; the expense of moulding and the charge that comes upon that expense would be too much to make it worth his while, since it amounts to the price for which they could be done in stone.

1477. Suppose it were doubled, or even trebled, would not the mere models or the cost of the bricks, for the use of a work of that kind, be a great proportion of the entire charge?—The increase would be so great that they would rather execute it in Bath stone.

1478. Is there any thing else you would wish to state?—I would wish to offer, with great deference, my opinion on the advantages derived from galleries of casts of classical objects in sculpture, in parts of architecture, vases, casts from bronzes and from fine works of all periods, botanical gardens and museums of natural history, open to the public, which, wherever they do exist, I have observed to be extremely frequented by the public in this country. I have seen and watched with very great interest the establishment and growth of institutions for the encouragement of the fine arts in Dublin, Edinburgh, Bristol, Birmingham and many other places; these have been raised by the subscriptions of individuals, often manufacturers themselves, very enthusiastic for the honour and for the real improvement of their native towns; but the means being very small, they have been obliged to support them by the attractions of fine art and annual exhibitions; they have not been able to bring them to bear more directly on manufactures to such an extent as they otherwise might have done; and I doubt not that if those institutions were in a situation to add to their means, by the encouragement and aid of Government, afforded under proper conditions, and were enabled to give rewards, and to hold out premiums for works wholly applicable to manufactures, that the original promoters of those institutions would be gratified and stimulated, and the ultimate objects of those interesting schools would be fulfilled; a permanent solidity would be given to those occasional and fluctuating efforts of enthusiasm or prosperity, of which we see so many examples, and the Legislature would obtain the desired effect at a much cheaper rate and more effectually, than by any other means I have been able to contemplate for the general improvement or application of art to manufactures. I am acquainted with many of these schools. I was in Birmingham the other day, and saw that since my visit eight years ago, a very respectable academy had been established there; and there are from 80 to

100 young persons learning drawing belonging to that academy, as well as independent schools, as that of Mr. Line's.

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1479. What are the class of persons attending there; are they artizans or sons of artizans?—Sons of artizans and tradespeople. Several schools are to be found in London, where instruction is given in the rudiments of drawing required by joiners and other artizans at a very low rate; but they are all on a limited scale, being started by individuals. I have a firm conviction, arising from long acquaintance with the subject, that there is a superabundance of artists in this country, and for one who thrives, a large proportion are without employ; and that the unsuccessful class are not so well paid as good mechanics. In this country there is a great propensity to art, and its attractive nature will always supply abundance of artists; but they have not been directed in a course to apply their art to manufactures, from the causes above cited, especially the want of scientific means, and an encouragement to this end, and legal security in their patterns.

1480. Has any decided improvement in the public taste taken place within the last 20 years?—Certainly, since the almost universal acquaintance of artists and the public with the Continent, the general prosperity of the times, and the improvement of mechanics, who were never so well paid as within that period.

1481. Do you consider that the continental taste is purer than ours?—Yes, unquestionably, and on better principles.

M. Felix Bogaerts, Professor of History at Antwerp, called in; and Examined.

Professor *M. F. Bogaerts.*

1482. WHAT means are adopted for giving the people of Belgium education in the arts?—We have different means. Our first schools are the Sunday schools: in them the children of the poor are instructed to the number, in the city of Antwerp, of from 7,000 to 8,000. Instruction is given not only in reading and writing, but also in design. The children educated in such schools are therefore qualified (so far as their future occupation may be connected with the arts) for the exercise of such occupation. Since the institution of these Sunday schools the intelligence of the people has been greatly developed in reference to the arts. Those children in the Sunday schools who show a disposition for the arts, are encouraged to pursue it. Not only, therefore, do they find encouragement in the workshops of the manufacturer, but (if they have a taste for superior art) in the studio of the artist. A vast number of painters at Antwerp have risen from the lowest classes of society.

1483. Are you of opinion that drawing should make a part of education?—Most certainly.

1484. Do you consider that the taste thus diffused amongst the people is not only useful for the improvement of manufactures, but also as a means of extending national taste?—Undoubtedly I think so.

1485. You have mentioned that the instruction of the people in art is first by means of these Sunday schools; what is the next step for the instruction of the people in art?—The next step is taken in the academies. The fine arts are taught at the academies; but that part of academical instruction which is devoted to manufactures, is only feebly developed in them.

1486. Do the workmen frequent the academies?—Certainly.

1487. Are the academies open to all the world?—Yes.

1488. Can the workmen attend the lectures of the professors of the academies gratis?—Yes.

1489. How are the professors paid?—They are paid by the city or town in which they lecture. Of all the schools of the academy, that which is most frequented is the school of architecture. There they learn perspective, the interior decoration of houses, and various branches connected with internal and external architecture.

1490. Are these Academies at which the workmen receive instruction common to all the cities in Belgium?—Certainly.

1491. Are there also daily schools in which instruction is given in drawing?—Yes.

1492. According to your representation, may we not infer that the knowledge of design and a taste for arts is very much diffused amongst the people of Belgium?—Decidedly.

1493. And that within the last few years the knowledge of design and a taste for

Professor *M. F. Bogaerts.*

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for arts among the people of Belgium is very much extended?—It has been very much extended indeed of late years.

1494. From what time do you date that extension?—From the last re-organization of our general system of instruction.

1495. How long is it since the general system of instruction was re-organized in Belgium?—Within the last 15 years.

1496. Since the introduction of design as a portion of national education, have the manufacturers of Belgium improved?—They have.

1497. Has the national taste improved?—It has.

Lunæ, 31° die Augusti, 1835.

WILLIAM EWART, ESQUIRE, IN THE CHAIR.

Charles Toplis, Esquire, called in; and Examined.

Charles Toplis, Esq.

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1498. WILL you inform the Committee how you are connected with the London Mechanics' Institution, or with the artisans and manufacturing classes of the country?—I am one of the vice presidents of the London Mechanics' Institution, and I am also director of the Museum of National Manufactures in Leicester-square.

1499. What part of the Mechanics' Institution relates to the instructing of artisans in design?—There are three schools, all of which are superintended by masters that are appointed for the purpose.

1500. Will you state what departments are taught by those masters?—There is one class for teaching geometrical and mechanical drawing; that is, drawing to scale with the aid of mechanical instruments; another class for teaching the drawing of ornament; and a third class for the human figure, and I believe there is a fourth class for landscape, at least there was some time ago; I am not sure whether it still continues, but I believe it does.

1501. Do they teach perspective?—They do in the geometrical and mechanical drawing class.

1502. Is that sort of instruction given which would enable a person to draw patterns for fancy goods?—That is one of the branches which I include under the designation of ornamental drawing; but it is not precisely that kind of drawing which has been practised in these classes; however it would give them the facility for turning their faculties that way.

1503. To a certain extent you educate them for pattern-drawing, do you?—Yes, by giving them the preliminary education, certainly, though it has not been expressly directed to that one object.

1504. Do you give them means of studying the beautiful specimens of the antique, either in statuary or in vases?—There is another class for modelling, where they have such specimens, though not to the extent they ought to have them; but they have minor specimens, such as their own means can command.

1505. Have you any gallery of casts?—No, only the casts I have just now alluded to; the detached pieces; we have no gallery of entire figures.

1506. You have no such gallery as would amount to an exhibition of works of art, have you?—Certainly not; there is a museum of models, apparatus and specimens of minerals.

1507. How do you think that those branches of the art of design which are taught in the London Mechanics' Institution suffice for the necessary education which would be desirable for artisans in design?—I think there is a very fair ground-work laid, but it would require extension; for instance, in that department, which has been mentioned of pattern-drawing, it ought to be carried out into that, and into other very important branches of manufacture, one of which may be cited, namely, the porcelain and earthenware manufacture.

1508. Have you ever had under your consideration the propriety of not only teaching the artisans design, but also of teaching them the connexion of design with the peculiar trade which they pursue?—I have attended to that, and have expressed my opinions upon those points in what I have written here.

1509. The

1509. The meaning of the question is this; suppose that you have a master to teach design, do you not think that it would be also necessary to have some person who should stand intermediately between the design and the fabric to which the design is to be applied, and show how the one is to be adapted to the other?—Yes, certainly; I conceive that the elementary schools of design would be of the same value for all; after they had made a certain progress in the schools, it would then be necessary to draught them out into the particular department of manufacture which their inclination or their talent might lead them to; that then they would require express instruction in those particular branches; for instance, in the porcelain manufacture, it is requisite that a painter there should be able to paint landscape and other natural objects, perhaps to compose pictures, but at all events he should be able to copy a landscape or other representation accurately; but then the management of the colours and other materials used in the porcelain painting requires express teaching, and that knowledge he must derive from some master appointed for the purpose; he would in fact have to undergo an apprenticeship in that particular art; but his previous preparation in the school of design would qualify him to attain the particular technical application of his art in a comparatively short time, so as to make his labours become profitable both to himself and his employers in that particular department.

1510. You are acquainted with the application of the designs to manufactures through the medium of the Jacquard loom, are you not?—I am.

1511. Is it not necessary in the application of design to the production of figured tissues there, that the artisan should to a certain extent be an artist, so as to know how he could call out the design into existence on the fabric which he is weaving?—That is not necessary to the weaver, because the loom is set for him.

1512. Is it not necessary for the person who sets the loom?—It is quite necessary certainly that this man should be imbued with the principle of design; he should have certain tastes, and know what forms will have the best effect upon the tissue.

1513. In fact, it is the intermediate instruction which applies the design to the fabric, is it not?—Yes; the workman himself has nothing whatever to do of necessity with the design; he weaves with perfect indifference all sorts of designs, the cards which give the pattern being put into the loom, and they operate the design without any knowledge of it being required on the part of the workman.

1514. Have you been in France?—I have.

1515. Have you had an opportunity of observing the means by which artisans are instructed in art in France, and the effect which such instruction has upon them, that is, by opening galleries?—In Paris, the splendid collection of the Louvre is open to any applicant there to study, to make copies from the pictures and from the statues. In Bourdeaux they have a similar collection, not upon the same scale as the Louvre, but they have a collection of pictures and of statues which are also open to any applicant to study. In Lyons, I believe, their schools are more expressly directed to their peculiar manufacture, namely, the silk manufacture. I believe it is the case in their university schools, that they are open indiscriminately to all students. The university of Paris and the medical schools are there open. They have also schools for the training of artisans; they are at present re-modelling or rather re-organizing, I should say, the Conservatoire des Arts et Metiers, and there is now a series of models made by the pupils of one of these schools, which are made in a creditable and workman-like way; that is, they are made to scale and correctly finished. They are going on to complete an entire collection of all the most useful machines that are employed in great works and in manufactures.

1516. Will you continue any observations you wish to make further on the subject?—In their manufactures generally which I have examined, there appears to me to be more care bestowed upon the ornamental part of it, and in many instances a better taste displayed, that is, more in conformity with recognized principles of taste than we generally observe in ornamented manufactures in this country. The close study of the fine forms of antique sculpture and painting manifests itself in a great number of the productions of their manufactures.

1517. What manufacture would you principally specify as exemplifying that?—I should advert chiefly to the porcelain manufacture and their ornamental casting.

1518. Should you mention paper as a specimen?—That I should also include, that is, their coloured papers, their hanging papers; in that they are very far before us certainly.

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1519. You have mentioned as one means of instruction in France, the gratuitous access to these collections?—Yes.

1520. Are there any other sources of instruction to which you would attribute the superiority you ascribe in design to them on the part of the artisans?—The particular schools established in particular districts where the manufactures are; I should say in Alsace, at Lyons and at Rouen.

1521. There are eighty schools altogether, are there not?—Yes.

1522. Is there any system adopted in France for teaching the artisan the intermediate process of connecting design with the peculiar branch of manufacture which he is to pursue?—That I believe exists at Lyons; they are expressly trained to that there.

1523. Would it not be very desirable to have that species of instruction given in England?—Unquestionably; it is my opinion that nothing would more facilitate the useful application of the art of design to manufactures than the appointment of intermediate masters to train the student from his general knowledge of design to particular branches of productive manufacturing art. They all bear such distinct characters that it becomes in fact a separate occupation: the man who is qualified for designing the ornaments of an iron-foundry would be at a loss to design for the paper-hanger or for the china-painter. In many cases the peculiar manipulation of the manufacture demands a peculiar knowledge and peculiar tact in the artist who is to design for that particular branch.

1524. Then the principle of your instruction would be, that you would give general education first of all in design, and next you would allow the artist to follow that branch for which he had a peculiar talent?—That branch for which he appeared best adapted.

1525. And in choosing that you would follow the principle of the division of labour, and turn his attention as much as possible to that?—Certainly.

1526. After that would you allow him, when his education had been sufficiently completed, to go forth and become a designer in any part of the country where there was a demand for such species of design as he had devoted himself to?—Yes.

1527. Do you think that persons so trained would find sufficient employment among the manufacturers?—I am quite of opinion that they would; and the readiness with which he would find employment amongst the manufacturers by any excellence which he had attained in these schools, would be a constant stimulus to exertion in the schools to reach that excellence. In France I believe it is found to be invariably the case, that when a boy has acquired a certain ability in the arts of design, and has shown taste and genius, he is eagerly sought for by the leading houses, and when he is of good moral conduct, he commonly terminates his career by becoming a partner in the house.

1528. Are you aware whether the statement you have made is not exemplified also by the extreme encouragement which some English manufacturers have afforded to design; taking, for instance, the well-known manufactures of Wedgwood and Davenport, who have been very anxious to encourage design?—Yes; and I have known several instances of manufacturers, particularly in the porcelain ware manufacture, who have been exceedingly inconvenienced for want of able artists to carry on their works. I know one house now that has had in hand, I think for at least four years, a service of porcelain for The King, and it has been retarded in its finishing a very long time by the manufacturer's inability to procure a sufficient number of first-rate hands to do the painting upon it.

1529. Would the manufacturers in those cases have to pay high prices to the artists whom they employed?—The manufacturers in such cases have to pay a higher price in the ratio of the scarcity of artists; yet there are in this country but a few first-rate artists in this branch of business, and they can command their own rate of compensation.

1530. You say the manufacturers would employ such persons abundantly?—I believe that class of persons in the porcelain and earthenware manufactures are well employed, that is, there is a constant demand for their services; but if you were to educate them, you would have the same ware which is now ornamented in very bad taste ornamented in good taste.

1531. In fact, in the instances you mention art is dear?—It is.

1532. And that proceeds from a want of diffusion of taste and design among the people?—Palpably so, because the greater part of these works of art are even works of very vile art; they take the worst of copies, and that is one instance of the want of education in the fine arts, in the superintendents, because they frequently take very imperfect works and give them to their workmen to copy. Were a general

a general taste diffused among the manufacturers as well as among the workmen, it would be as little expense to give graceful ornaments to their ware as it is to give the rude, barbarous coverings with which they still ornament their ware.

1533. Is not originality of design very scarce, and is not art chiefly confined to copying?—Yes, it is. I can give an instance of that; the common earthenware manufacture takes its style of ornament from China, that was brought over here many years ago; they still continue that barbarous style of covering which the Chinese had adopted. A very great improvement has been recently made in the means of multiplying the copies of designs for transfer to the surface of the ware, by printing off a continuous sheet, and such is the constant demand,—but this comes from the bad taste of the public perhaps,—such is the constant demand for the old Chinese barbaric ornaments, that they have been obliged to engrave their cylinders in the new machines to those patterns, though they have at the same time brought forward much more tasteful designs of their own; but still the great demand by the public has compelled them to adopt the old rude style of ornament.

1534. In the case you have alluded to in executing the order for The King, would there be greater facilities for executing that order in France than in England?—I should think there would be. It appears to me that they turn out their large pieces of porcelain much more abundantly than we do, and I know perfectly well that they do larger works with more facility than we can.

1535. You laid down the principle that having instructed the artisan to a certain extent in the general principles of design, you would then allow him to confine his attention to the particular branch of manufacture to which the design is applicable?—Yes.

1536. Have you ever turned your attention to the best mode of carrying that principle into effect?—Were I to set about it, I should take a man perfectly conversant with that branch of the business, and give him the pupils, and say, "Now you take those pupils, and instruct them in all that is necessary for this particular department;" in the instance of porcelain he would say to him, "You have been accustomed to use such and such colours, which are at once obvious to your eye; you know the colours you are going to apply to your picture by their appearance on the palette, and you know they will have the same effect to the eye which they have upon the palette; here you are going to encounter a totally different principle; you are taking a colour which is totally different in appearance to what it will be when it has been subjected to the process of burning. This is perfectly new to the student; he then has to be instructed in and shown what are these changes that take place in the colours in the operation of burning. This is a preliminary training which he must necessarily go through." Then there is the effect of different fluxes upon the colours, the effect of the different combinations of colours, the quantity of flux that is necessary for one colour and is necessary for another that are to be exposed to the same degree of heat; the colours that require different degrees of heat; and all these technical peculiarities must be taught to the general student of design. He is only qualified before he comes there by training of the eye and the hand; his eye can measure forms and trace their contours, his hand can make the copy upon a plane surface of those forms.

1537. The instance you have given in the case of porcelain, is an exemplification of the principle which would generally apply to the adoption of design in manufactures, is it?—Yes; for in the iron foundry, for instance, the student who had been taught to draw ornaments upon a flat surface, appropriate to that kind of material, would have to be taught when he comes to apply himself to this particular branch, that all kinds of forms would not be admissible; they would not deliver from the sand; he must have a peculiar knowledge of what will and what will not be manageable in the hands of the moulder, and then he comes to a peculiar technical training. That is another instance, and I fancy it will be found generally to prevail all through.

1538. In order to subdivide instruction in art in this way according to the manufacture to which it is to be applied, would you adopt any central system of instruction, would you educate masters in these peculiar branches, or what course would suggest itself to your mind?—I think it would be most economical to the public to establish these secondary schools in the field of the peculiar manufacture, as in the instance of the French silk manufacture they do at Lyons. All that applied to the connexion of the arts of design with the ornamenting of porcelain and earthenware, would be best taught in Staffordshire. The iron foundry is too universally spread to say where it would be best situated, but perhaps it is one of those

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those which would be best in London; and there are certain other diffused branches of manufacture, where a central school would be the only one which could be conveniently established.

1539. What would be the benefit of a central school?—The students would be more numerous, because you would collect them from the whole kingdom.

1540. Would the facilities of instruction be greater?—They would, because the greater the number of pupils, the more economically you can educate them. There is a central school in London, for what is called the teaching of art, but the misfortune is that there are no teachers; that is, the Royal Academy; the students are drawn there from all parts of the kingdom, and when they get there, there is very little or no instruction.

1541. How far do you think it would be desirable that the Government should interpose to assist in the formation of establishments, such as those you have recommended?—I think, as it contemplates a national benefit, that schools should be established at the national expense.

1542. You have laid down certain principles for the education of artisans in art; do you think it desirable or not, that besides the direct instruction which you have suggested, they should have also collateral assistance given to them by opening as much as possible galleries and exhibitions, where they might freely see all that is most beautiful in art, without any difficulty at all?—I think that is certainly desirable to the students, and I think it would have this further beneficial tendency, namely, that of improving the taste of the community in general, which wants educating certainly as much as the artists that are to minister to their taste.

1543. From your knowledge of foreign countries, do you think that the people of this country have had justice done to them in the way of instruction by the free exhibition of works of art?—I think not.

1544. Do you think that there is any want of talent for art in this country, or for a natural appreciation of it?—I think not; I think we have instances of as much fine taste in this country as has been exhibited in any part of the globe.

1545. Do you think that the people of this country have had equal advantages with most foreign civilized nations for developing their taste in art?—I think not.

1546. Do you attribute that to the want of free and open exhibitions to the public of works of art?—Yes, and I would instance another case in Paris, and the public gardens and buildings around there; they more freely ornament their grounds with fine works of sculpture than is done in any of our public places.

1547. Do you think that the climate of this country is any objection to that?—I think there is some little inferiority in the climate of this country.

1548. But there are some instances in which that does not apply, are there not?—Yes.

1548*. In iron statues they would not be affected by the climate, would they?—No, our metal statues stand very well; marble would be the thing that would chiefly suffer. I think it would be possible to form, at a moderate expense, large collections of plaster casts, which would improve the taste of the country equally with the originals.

1549. You have suggested the subdivision of the study of art as applicable to different manufactures; you have also suggested the expediency of open galleries accessible to the public; will you, in the third place, say whether you have ever thought it would be a desirable thing to make design to a certain extent a portion of national education; that is, wherever there are popular schools of education, day schools, authorized more or less by the Government, and formed on a systematic plan, you would then use means of infusing a certain knowledge of the principles of design into the minds of the population?—I am of opinion that the arts of design are so extensively useful to almost all classes of operatives, that after the first elements of teaching, such as reading, writing and arithmetic, I would make the arts of design a necessary concomitant of that branch of education.

1550. Do you think that such a system would be useful to make our workmen better artists, and to create in the people a greater demand for works of art, and to elevate their minds, and enlighten their understandings?—I am quite of the opinion that that would follow, and I have here expressed it.

1551. Would it be a difficult thing by any means to make, to a certain degree, the knowledge of design a part of national education?—Not at all; I think it is quite as easy to teach the arts of design, as it is to teach the art of writing.

Mercurii, 2° die Septembris, 1835.

WILLIAM EWART, ESQUIRE, IN THE CHAIR.

Charles Toplis, Esq. called in; and further Examined.

Charles Toplis, Esq.
2 Sept. 1835.

1553. AS you are particularly familiar with mechanics' institutions, will you state to what extent and in what respects the constitution of those institutions is favourable to the development of art?—With the permission of the Committee, I will begin with giving a general statement of the objects of mechanics' institutions. The spontaneous origin, the progressive extension and the steady self-maintenance of mechanics' institutions throughout the country, are indisputable proofs of the existence of a strong desire for knowledge of a different character from that which the active classes of the community could heretofore derive from the educational establishments to which their station, leisure and pecuniary resources gave them access. The contracted and inflexibly perverse appropriation of the endowed schools of the country to the gratuitous dissemination of that kind of knowledge which never was, nor by possibility ever could be, of the smallest practical utility to men devoted to productive industry, had long since rendered the proffered boon of free instruction a mockery to that portion of society for which free education was ostensibly designed. In sterile schemes of tuition, calculated merely to rear men for the cloister, the mechanic, the handicraftsman and the peasant found nothing to aid them in their pursuits, and they had of necessity abandoned the free-schools of the country to the few whose leisure and resources allowed them to waste the whole term of education on the profitless acquisition of the Greek and Latin languages. The funds which had been appropriated to the gratuitous spread of information amongst the multitude, had become the succour of a limited few, who were pursuing what is deemed the necessary course of a professional education through the least expensive channels, or they had lapsed into the sinecure emolument of wholly unoccupied public instructors. The private seminaries which admit scholars for pay, are either too expensive for the resort of the many, or the course of instruction within them is too meagre for the wants, or too foreign from the pursuits, of the productive classes which constitute the bulk of those whose necessities demand cheap education. The people, who felt the privation and saw the necessity of appropriate elementary instruction, communed with each other on their common wants, and combined together to effectuate the object of their common desires. They associated themselves for the purposes of mutual improvement, and under the impressions of their peculiar necessities devised for themselves methods and matters of study which assorted with their avocations, their leisure and their pecuniary means. Ten years of experience have now shown at how easy a rate, through associations like the self-created mechanics' institutions of this country, sound, profitable, practical education may be disseminated amongst a people. The money contributions of the individual members are so moderate as to be little burthensome to very large bodies of the community. These periodical payments range from twelve to twenty-four shillings per annum, divided commonly into quarterly payments. The aggregate amount of the contributions commonly suffices for the hire of a building, the salaries of one or more residentiary officers and attendants, the remuneration of teachers and lecturers, and the accumulative collection of books, instruments, apparatus and illustrative models and specimens.

1554. Do you think it desirable that the pupils should themselves contribute to sustain the establishment in which they are instructed?—I think so; and therefore I have brought this instance before the Committee, to show how it works, and how easily it might be put in practice upon a large scale, to spread this kind of information. They attach more value to what they pay something for. It would be very desirable to give them education, at a trifling cost to themselves, by a little public assistance. In some cases a further expense is entailed upon the individual members for the purchase of materials consumed in the process of in-

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struction, as paper, pencils and the like, or of elementary books of constant needful reference; but such extra expenses are incidental to all plans of instruction. The great burthen on the resources of these establishments is commonly the erection or rent of buildings; the larger establishments have, for the most part, found themselves under a necessity of building, in order to adapt the premises to the purposes of the institution; this has been almost invariably the case where a theatre has been required, and in such instances rent, interest and liquidation of debt absorb a large proportion of revenue. Were the buildings and endowments now nominally devoted to the eleemosynary instruction of the people appropriated to the diffusion of that kind of profitable knowledge for the attainment of which mechanics' institutions have spontaneously sprung up, and were they subjected to the control and management of those whose interests coincide with the judicious and honest administration of them, the rational, wholesome, effective education of the people might be effected at a cost which the country could not feel, aided by the contributions of the scholars, so trifling that no class would feel them as a burthen. The methods of instruction adopted in the mechanics' institutions are usually by periodical lectures, by schools superintended by masters, by classes for mutual instruction, by reading-rooms, and by libraries for circulation. It is only in the larger establishments that the system of lecture instruction can have a permanent character; in the smaller ones the lectures are delivered in sessions of longer or shorter term, or sometimes only in casual courses. In the London Mechanics' Institution lectures are delivered twice a week during the whole year. From the miscellaneous pursuits of the members of these institutions, it would be inappropriate to pursue any one branch of study through a long series of consecutive lectures, like the academic courses; the courses therefore are short, and calculated by illustration to facilitate the progress of students in their private labours. For lectures of this character the larger institutions are generally enabled to compensate the services of men ranking high in science and literature. The schools are distributed into distinct branches, so that only one object forms the pursuit of each; they are superintended by a master usually receiving a salary for his services. The branches of study followed in the schools are those which call for the more continuous application of the student under the guidance and correction of a proficient. The classes for mutual instruction are commonly made up of such as, having made a certain progress in any inquiry, are qualified, by a little extraordinary application, to compose lectures or essays, which they do in turn, and read to the class, which subsequently discusses the matter of the essay or lecture. In these classes many of the more important subjects of investigation, such as those of mechanical and chemical philosophy, are prosecuted more at length and examined more in detail than they can be in the condensed course of lectures publicly delivered on the same subject. The branches of instruction cultivated in mechanics' institutions being appointed, as it were, by the students themselves, may be assumed as indicative of the necessities experienced by the majorities of those classes of the community which have coalesced for the formation of seminaries for their own use. The training for the workshop and for the study are essentially distinct. Our public free-schools recognize no difference, and have been modelled on the monastic institutions, which had for their main end the qualification of men to converse of and with the dead. Our engineers, our smiths, our carpenters, our draughtsmen find no assistance in the dead languages; they covet to know the principles of science which may guide and correct their judgment, and to possess the elements of art, which may shorten their labour, and give the stamp of mastership to their works. In pursuing the course pointed out by the experience of their own wants, they have founded for their own use lectures, schools and museums, to teach them the principles and facts of mechanical and chemical philosophy, and to initiate them into the practice of the arts of design. With these guides, and after such preparatory discipline, they know that they shall become more skilful constructors, more ready contrivers, more expert workmen and more tasteful designers; their works will have more solidity, more fitness and more grace. Already numerous instances might be selected from the students in these schools, whose talents therein drawn forth have raised the individual higher in the social scale, and have stamped a national value on the system which had given them birth.

1555. Can you supply the Committee with any statement respecting the number of pupils in the London Mechanics' Institution; also an account of its funds and expenditure; the number of instructors, and the usual details which are laid before

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before such institutions annually?—I can furnish to the Committee those particulars. *Charles Toplis*, Esq.

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[*The Witness delivered in the same.*—Vide *Appendix*, No. 3.]

1556. What proportion do the pupils attending the schools of design bear to the pupils generally attending the Mechanics' Institution?—They are obliged to go out after attending a certain number of courses, to make room for others. I think there are five classes of drawing schools.

1557. Do you know how many working mechanics belong to the London Mechanics' Institution?—I should think not above one-third of the number; the average number is about 1,100; our number has been stationary at that for some years; and I should think one-third of them may be called mechanics, for there are a vast number in London who are in some way or other connected with arts of production that are not strictly mechanics. There are a great number of clerks that form part of the members; and particularly law clerks, for we are just in the centre of the law establishments, and we have a vast number of lawyers' clerks among them.

1558. What portion of the instruction do they attend?—They take what courses they please; they all follow their own inclinations as to the classes they will attend; they make application to the secretary, saying "I wish to attend the drawing class," or any other.

1559. How do you account for the circumstance that the number of pupils attending has been stationary for so long a time?—That seems to be the average supply within the range of the institution; they cannot come a great distance, though we have some few whose zeal brings them from the outside of the town; but placing your building at any one point of London, you will range within a certain circuit, and that circuit appears here to have furnished very steadily 1,100 members. There are other establishments about London differing a little in character.

1560. Are there any other mechanics' institutions in London?—There are several that have emanated from that; some of them for classes considering themselves rather higher in the scale of society than those for which the London Mechanics' Institution was originally formed. For instance, there is the Western Literary and Philosophical Institution in Leicester-square, which has been going on very flourishingly. There is a more recent establishment in Mary-le-bone, of the same kind, which is called the Mary-le-bone Literary and Scientific Institution. There is another, near Finsbury, called the Mechanics' Hall of Science. There is the Mechanics' Institution in Spital-fields, which has flourished less than one would expect in a manufacturing district; the wages have been very low there; and that institution, though it began under very favourable auspices, has been always drooping, scarcely keeping itself in existence. There is another in the City, the City of London Literary and Scientific Institution. There is one at Islington, and another at Stepney. There is another recently established at Stratford. There was one in the Borough, but I am not certain whether it is still in existence; I rather think not. There is one at Wandsworth, and there was one at Deptford, but whether that is continued since the change in the Dock-yard there, I do not know; it was a good deal supported by parties connected with the Dock-yard.

1561. Have they increased much in number of late years?—They have increased in number, and those which I have mentioned are tolerably stationary as to the supply of members; that is, they have a sufficient number to keep themselves in full activity.

1562. Has the number of pupils increased much?—I should think they are pretty stationary as to numbers.

1563. Are they all upon the same system?—No, they are not upon the same system; they have each adapted themselves to their peculiar views; some taking different classes of society, and they have adapted their pursuits to the wishes or wants of the particular class forming the society. Some will pursue more literary subjects, others matters of science or matters of taste; music forms a leading object with some of them.

1564. Do they all afford more or less instruction in arts connected with manufacture?—They all, I believe, afford instruction in drawing.

1565. Can you give the Committee any details as to the number of pupils in each?—Not of those other institutions, without a special application to them.

1566. How far do you consider a knowledge of the arts of design to be im-

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portant to artisans and manufacturers?—Whilst a knowledge of the principles of mechanical science is indispensably necessary to the successful execution of all works of construction, and consequently to the engineer, the builder, the carpenter and the mechanist, it is an essential part of his education to acquire it; chemical science is not less imperatively called for by equally extensive classes of operative men in innumerable departments of manufacturing industry; but to a very large proportion of the individuals engaged in both branches, some practical skill in the arts of design is either absolutely needful, or would be eminently useful. All works of construction require to be preceded by a design on paper, or a proportional delineation, which is often to be done by the workman himself. Workmen in these branches must therefore be necessarily trained to the accurate use of drawing instruments, and their operations are frequently much assisted when they can express their designs by sketches made by the unguided hand. Those workmen whose province it is to shape and give form to materials, are greatly aided in their operations when they can delineate the contours of the forms they wish to impart, or can model them in a yielding matter; and their taste is necessarily improved in studying the selected forms set before them for imitation during the course of their instruction in drawing or modelling, from which improvement their works must derive additional grace and effect. Many important branches of manufacture call for careful cultivation of the eye, for the purpose of arranging, assorting and contrasting colours, which, as an affair of taste, calls for some portion of a painter's education. Other branches subservient to the luxuries, and what may indeed be regarded as the imperative wants of a highly civilized society, demand superior skill in the delineation of landscape, and even in the drawing and modelling of the human form, and of other complex figures. As any of these operations are executed with a skill and tact to satisfy the chastened eye of the professed artist, they give value and importance to the work which has received their impress, and enhance the gratification of the cultivated possessor of the commodity. Whatever partakes of the nature of ornament will only be appreciated in a refined age, as it is characterized by grace and elegance of design and by delicacy and precision of execution. But the accomplishment of these requisites implies long and careful training in the artist, to whom, during his unprofitable noviciate, it is essential that all facilities should be afforded at their minimum of expense. When we consider the immense number in this country of workmen and superintendents, to whose successful operations the principles of science are essential; of skilled labourers, artisans and handicraftsmen, to whom the arts of design and the elements of taste in the cultivated age of an opulent society are of eminent, to many of vital, importance; when we reflect that from the knowledge and skill, and ingenuity, and taste and labour of all these men combined, the country draws all which supplies the wants, conduces to the comforts, or ministers to the luxuries of society, it would seem to be an object of no mean estimation to an enlightened Legislature to provide for the careful and adequate training, as far as public institutions can contribute, of every class of skilled labourers. The formation of schools of elementary science, of academies for the arts of design, and of museums for the collection of models of construction, of specimens of skilful workmanship, and of examples of tasteful design and graceful form, cannot fail to advance, in a conspicuous degree, both the fine and useful arts of the country. Our national greatness rests on the skilled industry of our people; it must be a part of sound domestic policy to foster, by every means within our reach, the talent which gives currency and importance to our indigenous products, and draws within the vortex of British manufacture the raw material of other climes, to be spread again over the world, enhanced in value by the labour, skill and taste of British artisans.

1567. Have you ever turned your attention to the propriety of giving protection to original designs, giving a species of copyright to them?—I have considered it a good deal, and have had much conversation with manufacturers upon it. It is a subject of heavy complaint with manufacturers that they have now so little protection in their original designs; so little protection, indeed, that they feel in many cases little disposed to incur the expense of paying artists to produce designs for their particular establishments, knowing that after they have incurred that expense they are open to piracy the next day, if they produce any thing likely to take with the public. This operates prejudicially through very extensive classes of manufactures; all, in fact, where figure or design forms a prominent feature of the production. The present protection is little available; it is an expensive process

process in Chancery which very few men choose to resort to. It has been done by some houses in Manchester, but not very extensively. I believe it requires an application to the Courts of Chancery to grant an injunction against the continuation of the piracy, which is attended with some considerable expense and trouble to the applicant, and expense and trouble that are more than equivalent frequently to the object to be protected. The great difficulty in devising security to designs, I believe, is that of defining clearly what is an original design; you can so easily, by an alteration of subordinate parts, retain the character, and still it cannot be said to be a copy of that particular work. This would require a good deal of consideration by men conversant with manufactures and with art, to be able to produce a ready recognition of the original design which each individual might be entitled to claim; there are so many easy ways of evasion. The protection asked for would in general be for a very short time, as commonly those things of pattern merely are in demand for a season, and they would be satisfied if they could have only a few months' monopoly in some branches of manufacture. In other branches of manufacture, where the taste is more durable, the protection would require to be longer. It would have to be classified, and put under the consideration of a qualified Board; perhaps the whole affair might be effected by registration in an office superintended by men possessed of practical knowledge in the different branches of manufacture. It might be done at little expense to the individual seeking the protection, without the formality of a patent.

1568. Would you have the registration central or local?—I think it would be better to be central, because it would be so easy to transmit to that office the pattern desired to be registered.

1569. Would you combine both a central and a local registration?—I am not prepared to say that there are some manufactures so extensive and so peculiarly confined to a district, that you could do all for that one branch of manufacture in the district; but then again, there are offsets from those same manufactures, and those offsets would have, in coming to the local head office, as much trouble almost as would bring them to a common central office in the metropolis; for instance, in the earthenware manufacture, which has its chief field in Staffordshire, they could do all that related to the great branch of the business; but then you would find small detached portions of the manufacture situated at considerable distances, isolated from the large fields; so in printed cottons, it would be the same, and in the weaving of figured goods it would be the same. You find them distributed here and there in certain localities all over the kingdom; so that perhaps one central office would be more convenient than the having a number of local ones.

1570. In your plan of registration, would you adopt any system of marks upon the article?—I would deposit a copy in the office, which should have the official mark of its date of reception, which should be the date of its publication. I should give a claim from the moment when it was deposited in the office; then if another man could prove that he had, before that date, made use of this design, it becomes no piracy; the other has made a claim that must fall to the ground.

1571. Would it be desirable to have any stamp or mark put upon each article made by the person who had so registered it?—I think it would be well to say, "Registered on such a day, at the office. by such and such parties," and let them put it upon every piece of manufactured goods that they made.

1572. That would leave no excuse to any person that saw the article for pirating it?—None whatever.

1573. Have you any observations to make with respect to the expediency of having a speedy remedy, through a legal or equitable tribunal?—I think that such questions would be most advantageously settled by a local tribunal, as upon the Continent, and particularly in the large towns in France; they have tribunals to which all matters of this kind are immediately referred. Their chambers of commerce are local tribunals to which all matters of dispute between merchant and merchant at once go and are settled, instead of coming to the metropolis of the country. There is a Board composed of men skilled in that particular branch. That would be at once a cheap and a ready remedy. Such a court might proceed upon the decision of the office of registration; the piracy being sent up to be compared with the original design deposited there, they would at once issue their declaration whether it was a colourable imitation of such and such a design or not. That might

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might be admitted as evidence before the local tribunals, to guide them in their judgment in the appeal made to them.

1574. You would not think that one decision by such central tribunal would be sufficient?—I think perhaps not, because you might have to investigate and call for the *vivâ voce* testimony of the parties, which would be best done in the locality where the transaction took place, rather than bring them to a distant court; I think all that would be required from the office of registration would be a testimonial as to the identity or similarity of the two things in contestation.

1575. Must not you for that purpose send up to London sometimes articles of inconvenient weight to be examined?—That would happen sometimes, but very rarely; it seldom happens that those matters of taste are very weighty.

1576. In the case of fire-stoves, and other productions of that kind, might not that inconvenience arise?—Then you come to patented inventions; but if they were merely the ornamental designs upon a casting that could be sent at no great expense, it would be sufficient to send the plate upon which the design was.

1577. Have you any further remarks to offer upon the subject of protection to the original designers of patterns?—I think it of great importance to the manufacturers of the country that a speedy remedy should be afforded for this widely-complained-of grievance.

1578. And you propose that the period of protection should vary according to circumstances?—According to the nature of the manufacture.

1579. Must not you give some power of punishment to the tribunal?—Of course there must be some power of that kind; I believe a fine would be found necessary in all those cases.

1580. Have you been induced to make any remarks upon the effect of the Excise laws upon the progress of the arts, in connexion with manufactures?—My general impression is, that where the Excise laws are in operation in any branch of manufacture, their tendency is to retard improvement in that branch of manufacture.

1581. Have they also obstructed art, as well as mere mechanical improvements in manufacture?—In the art of glass-making, I believe it is universally acknowledged that the want of improvement is mainly to be attributed to the Excise interference; they cannot make any experiments as to improving the quality of glass except under the inspection of the Excise, and it is that prohibition which forms the stumbling block in that particular branch of art. There are certain qualities of glass for optical instruments that we have never been able to reach in this country, and we are obliged to go to the Continent for them now, in consequence of the imperfect state of glass-making.

1582. Do you consider that to result from the Excise laws?—I should ascribe it to that, in consequence of its having prevented the free career of experiment in that branch of industry.

1583. How far do you think the assistance of Government is desirable, in the formation of such institutions for circulating art, or for the foundation of open galleries for the public?—I think the assistance of Government would be exceedingly useful in furnishing the buildings in which those schools were to be established, leaving the remuneration of the masters, in a great measure, to the contributions of the students. With regard to the museums, they, of course, must, if formed, be formed entirely by the Government, because to be useful they must be open; but the Government might very readily diffuse over the country museums, containing specimens of the fine arts, at a very trifling expense, by having a central establishment, in which they would have moulds from the best works of antiquity, and from those moulds they would be able to disperse casts in plaster to a great number of those establishments, so that they would be furnished at a very moderate expense through the whole country by this one establishment.

1584. Would not such a Government undertaking repay, in national advantage, the original outlay which it cost the national funds?—I think most certainly so, in improving the taste of the artists, and also in improving the taste of the community at large, for they must both be educated together.

1585. Would not such a central system of supplying objects of art be much cheaper than any other?—I think so; the Government could readily provide itself with those moulds from the original sculptures, whether they were in this country or abroad, and those moulds would supply a sufficient number of casts, in a state of perfection, for any number of museums that might be established in the country.

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1586. YOU conduct the Mechanics' Magazine?—I do.

1587. How long have you conducted it?—From its commencement, about eleven years ago.

1588. Has it diffused a great deal of information among the artizans of this country?—I trust it has; it has a very extensive circulation.

1589. Have you had an opportunity of observing whether there is a want of drawing among the working mechanics?—I should say there is a very considerable want of a knowledge of drawing; but I would qualify the observation in this way: It is not so much an ignorance of the uses of drawing, its intent and meaning, as a want of personal skill in the practice of it. I have scarcely ever found among mechanics (and I have had intercourse with a very great many) an instance of their not being able to comprehend perfectly any geometrical drawing that was submitted to them. It is a common saying among them, that they can comprehend any form of construction better from a drawing than from the best written description. Indeed as most of them work from drawings and patterns, it is absolutely necessary that they should be able to do so. They can read drawings, if I may so speak, and understand them thoroughly, though they cannot themselves draw; just as many a man can read and understand our best authors, who if he were himself to take pen in hand could not write a single sentence grammatically. I may add also, that I do not think it is from want of opportunities of acquiring a knowledge of drawing, or from any neglect of those opportunities, that the majority of mechanics are thus ignorant of drawing, but because they have had no occasion to practise the art.

1590. Why have they had no occasion to practise it?—It seems to me to be but a necessary result of the great extent to which division of labour is carried in this country. Every man of the working classes looks out for and studies that branch of art only by which he expects to get a living; he confines himself to that alone. Take for instance the case of any large manufactory; it does not require probably above four or five good draftsmen to keep two or three hundred men constantly at work. Of course it would be labour thrown away for the great body of those men to acquire any greater knowledge of drawing than is requisite to enable them to comprehend the designs entrusted to them for execution.

1591. Do not you think it would be of advantage to every mechanic to be able to draw?—I think it would be a great waste of time in any mechanic to learn an art that he could not turn to some practical account; and I think that it is from a conviction of this among mechanics themselves that they refrain so generally from cultivating drawing.

1592. Is not it a deficiency of the system that in that general division of labour there should not exist classes occupied in adapting the principles of design to general use?—I believe that in every trade there is a natural demand for designers, which produces as many designers as are wanted.

1593. Are those designers sufficiently instructed?—I think they generally are sufficiently instructed. I have never met in all my experience any want of talent in designing in any branch of manufacture.

1594. Have you ever had an opportunity of comparing the designs made here with the designs made in France?—Not from visiting the workshops of France; but I have seen numerous French publications of works of art, and such specimens of French art as have been imported into this country, and I do not consider that we are behind our neighbours, except in a very few branches.

1595. You do not consider that we are in general behind the French in design as applied to manufactures?—Not behind the French, certainly.

1596. On what facts do you ground that opinion?—On the proved ability of the English artizan to do any thing you can put him to as well, if not better, than any other artizan in the world, provided only you can pay him what he calls living wages for his labour, which are, unfortunately, with us much higher than in any other country; and on the fact that many of those fine designs for which the French have the credit are in reality the productions of our own mechanics. You commonly hear it said that the patterns of French prints are much superior to ours. Now it is notorious (abroad at least, if not at home,) that most of the engraved cylinders used in France are supplied from this country. A friend of mine went into a mercer's shop in Paris, and was shown there some very beautiful printed cloths; chintzes, I believe; he dropped an expression of surprise that our

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English manufacturers could not produce such elegant patterns as those he saw before him. The shopman smiled and replied, "To tell you the truth, sir, the cylinders from which these cloths were printed, came from Manchester."

1597. That applies to the printed cotton manufacture?—Yes, to that particularly.

1598. Do you mean to extend that observation to all the more fanciful descriptions of goods in which design more peculiarly enters, as well as to the cotton manufacture?—I really do not know how to limit the observation, for though the French do perhaps excel us in fancy goods, I think this is more owing to the talents of our artizans being employed in a more profitable direction, than to any inferiority of taste in them. The great object with every English manufacturer is quantity; with him, that is always the best article to manufacture of which the largest supply is required; he prefers much a large supply at a low rate to a small supply at a higher; and that even should the present profit be less from the former than the latter, because in the long run, the larger the demand, the steadier it is sure to be. I do not think this is a point which has been sufficiently considered. From the great command of capital possessed by the English manufacturer, the immense capabilities of his machinery, and the unrivalled skill and industry of his workmen, he is enabled to turn out a greater quantity of goods in a given time than the manufacturer of any other country whatever; while our wide-spread commercial relations present him with facilities of disposal such as no other manufacturer enjoys. He lays out himself accordingly to supply those manufactures that are most in demand all the world over; and those that are the most in demand among mankind at large will in the nature of things always be of the least tasteful description; that is to say, till the bulk of mankind are much more cultivated than they now are, or are likely soon to be.

1599. Do you think, that if they exercised a greater degree of taste upon the same material of manufacture there would be a greater demand for that manufacture?—I doubt that very much; the taste, such as it is, does not seem to be any drawback on the demand. You must improve the public taste greatly before you can expect to witness any material improvement in the productions of those who minister to it.

1600. How would you improve the public taste?—That is the question for consideration.

1601. Is not the public taste improved by the sight of works of good design?—Decidedly.

1602. Do you suppose, if works of good design went into the market with works of bad design, that in the end the works of good design would not be preferred?—I am not sure of that; I think the public eye requires to be educated in matters of taste, in the same way that the understanding requires to be enlightened by reading and study.

1603. Do not you suppose that the public eye is enlightened, in matters of taste, by the exhibition of well-designed works?—No doubt; the more habituated the eye is to the contemplation of beautiful forms, the less relish it will have for the grotesque, the gorgeous and the glaring, in which rude and vulgar natures delight; and hence the superiority of the educated and travelled classes in all that regards matters of taste; the same pattern which, for elegance of drawing and delicacy of colouring, would be appreciated, and, because appreciated, universally sought after in the west end of the town, would, in all likelihood, be passed over unheeded, if not contemned, in Wapping, or any similar neighbourhood.

1604. Is it not the inference from that, that it is desirable to improve the taste of the persons at Wapping, who do not so highly appreciate that which is well designed?—Most desirable, certainly; the taste of the entire public wants improving; but as regards the mechanical classes, I think they are rather before than behind the public taste in this respect.

1605. Then how do you account for the circumstance which has been stated in evidence to this Committee, that many patterns, particularly in the silk manufacture, which are brought over from France, are greedily sought for, and copied, in preference to those of our own workmen?—I ascribe the demand for French goods partly to a taste, a vulgar taste it may be called, for what is far-fetched and high-priced, partly to the actual superiority of the French patterns, many of them derived, as I have before stated, from an English source, and partly to fashion, for which you can often assign no reason whatever. A cylinder, engraved at Manchester, is sent to Lyons, and the article printed from it comes back here, and is very

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very much in request as a French pattern among persons who know nothing of its history, because, of course, the person that supplies the engraved cylinder to the French manufacturer, does it upon the understanding that he will not make the pattern engraved on it previously known in this country.

1606. Then you do not admit that any actual superiority, in point of taste, exists in France?—I do not know any thing that our artizans are not capable of producing, taking this always into consideration, that the price of food in this country is such that it will not allow them to devote to many descriptions of work the same length of time which foreign artizans, with their cheaper means of subsistence, can afford to expend upon them.

1607. You have said that at the west end of the town you think there is a better taste than at Wapping?—Unquestionably; it is a highly educated taste; the best of which the country can boast.

1608. At the west end of the town, do you, or do you not, find the goods of foreign manufacture more in demand than at the other end of the town?—I believe they are.

1609. Then how do you reconcile that with the opinion you have expressed, that the English manufactures are equal in taste to the French?—That is not exactly the opinion I expressed; I have admitted that the French do probably excel us in fancy goods, but I claim for our English workmen the merit of producing many of those patterns for which the French get credit; and I claim for them also the ability to do any thing which any other artizans can do, if you will but make it worth their while.

1610. Do you then suppose that all the French goods that come here are founded upon English patterns?—Not the whole of them, but I apprehend that a great part are.

1611. Do you suppose that a great part of the fancy silks which are consumed at the west end of the town are founded upon English patterns?—Not the fancy silks; that is a branch of manufacture long peculiar to France, and which, for various reasons, is as yet but in its infancy in this country. My observations have reference to the various cotton and linen fabrics, in which the arts of design may be carried to as great a degree of perfection as in silks.

1612. Are they carried to as great an extent as in the Jacquard loom?—They are not, but they might be.

1613. With respect to various articles of manufacture, in which the fine arts are exercised, for instance, the time-pieces and figures in or-molu, the candelabra, and various articles of that kind, which are formed upon classical models of the antique, are they principally the work of English artists, or do they come from France?—I believe the greater part of them come from France; but I am satisfied our artists could produce equally good articles of that description, if we could afford or chose to pay the higher price, which would be requisite to remunerate them.

1614. Why must they have a higher price?—Because provisions, and consequently wages, are high.

1615. How comes it that we can undersell them in cotton goods?—Because machinery has here to a great extent superseded human labour, and because in the case of cotton goods there is an immense supply to compensate the manufacturer for low prices.

1616. Then there is not a demand for fancy articles of the kind mentioned?—Yes, a demand for them among the higher classes, but little disposition on the part of English manufacturers to embark in the production of them; they prefer turning their attention to things of a more ordinary description, which every one wants. It was mentioned by Mr. Toplis that in the case of a set of porcelain preparing for The King, the work was stopped in its progress for want of artists of sufficient skill. Now, I should think that was very likely to be the case, and yet I should be slow to deduce from it an inference to the prejudice of our native artists. Kings can never be numerous as customers, and no manufacturer would ever think of rearing up designers for the special purpose of supplying an occasional order from such a quarter.

1617. Then do you lay down this principle, that it is in vain to offer to the great mass of consumers works which combine with perfect manufacture elegance of design, because they would not be appreciated by them?—I think, considering the existing state of taste among the great mass of consumers, you might produce patterns so elegant that they would not sell; for instance, in the negro markets

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of the West Indies and America, which take a large supply of goods from this country, the more gaudy an article is, the more of red and yellow in barbarous combination there is in it, the more likely it is to please.

1618. Is not that an extreme case?—I hardly think so; our fabrics go over all the world. People of taste are fond of complaining of the many ugly patterns which our manufacturers are constantly sending forth, when with the same trouble, and at the same expense, so much finer patterns may be produced; but they would not do so, if they only considered how many ugly tastes our manufacturers have to cater for.

1619. Do you apprehend that the ware of Wedgwood was indebted for any of the preference shown to it to the delicate design upon it?—No doubt the elegance of the design contributed to the circulation of the ware.

1620. Has the Wedgwood ware been in general use?—In universal use.

1621. Is not the design upon that ware a classic pattern from the antique, brought from the extremities of Italy?—Some of it is of that description, some not; but it is the general character of the ware.

1622. Do not the designs which are most sought for by the great mass of consumers proceed from the excavations of Pompeii?—I doubt whether those are the designs most sought after; there is a pattern which was a long time in very general use for table services, called the "Willow Pattern;" there is nothing very classical in that.

1623. Do you suppose that, if the ware be equally good, and the design more elegant, in course of years the consumption would be greater or not?—I have no doubt that such an increase of elegance in the productions of our potteries would help to improve public taste, and to produce an increased demand for articles of a higher cast.

1624. Do you think that in the long run, that which is founded upon admitted principles of beauty, is more certain ultimately to prevail, than that which is founded merely upon the ephemeral taste of the day?—I have no doubt of it; but I think the public mind must be educated to distinguish what is beauty and what not.

1625. Do not the artizans of this country form a great portion of the public of this country?—Yes.

1626. Are not they consumers as well as producers of manufactures?—No doubt.

1627. Do not they consume the articles produced by others, as well as manufacture themselves?—Yes.

1628. Then if you educate the eye of the artizan of this country, would not you educate the eye of the public?—Yes; so far as the artizans make a part of the public; I do not mean to question that the artizans at large share in whatever degree of bad taste distinguishes the country, but I repeat that in my opinion they are rather before the rest of the community in this respect.

1629. Do you know what proportion the artizans of the country bear to the whole population?—I cannot at present state the exact proportion; probably a fifth or sixth; but whatever the proportion may be, I apprehend it matters not. I know that an impression to the effect I have just stated does exist very extensively among our artizans themselves. Nothing is more common than to hear such of them as have any thing to do with the designing or planning of works, complain of the manner in which they are constantly thwarted by the bad taste of those who employ them. The tailors have got a phrase among them which describes this feeling very exactly; they call it "working to the head," or fancy, of the customer.

1630. Are there any means of giving a proper turn to the head or fancy of the customer?—Many.

1631. What means?—I would particularize, before all others, the circulation, as widely as possible, of good copies of the best existing works of art.

1632. Do you suppose that the taste of the customers would be influenced materially by the circulation of good works of art?—Most materially; I consider that very much of the bad taste of the country has been owing to the circulation of wretched prints all over the country, and still more wretched stucco images; the country has been inundated by them for the last 50 years and more. I may observe, by the way, as not a little curious, that this inundation has not proceeded from native artists, but from Italians. It is from Italy itself, the favourite seat of the fine arts, that this flood of execrable taste has come in upon us.

1633. Do you attribute the employment of Italian designers upon those inferior works to the circumstance that the demand of the purchasers originates from a low taste in art?—No doubt they consulted the taste of their customers.

1634. Do

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1634. Do you consider that the multiplication and circulation of copies of good models would have a great influence in refining public taste, and producing improvement in works of design?—An incalculable influence.

1635. Do you consider that the progress of the arts in this country is impeded by the want of protection for new inventions of importance?—Very much impeded. Inventions connected with the arts of design, of new instruments, or new processes, for example, are, from the ease with which they can be pirated, more difficult of protection than any other inventions whatever. Such protection as the existing laws afford is quite inadequate. I cannot better illustrate my meaning, than by mentioning the case of engraving in metallic relief, an art which is supposed to have existed three or four centuries ago; and the re-discovery of which has been long a desideratum among artists. Albert Durer, who was both a painter and engraver, certainly possessed this art, that is to say, the art of transferring his designs after they had been sketched on paper, immediately into metallic relief, so that they might be printed along with letter-press. At present, the only sort of engravings you can print along with letter-press are wood-engravings, or stereotype casts from wood-engravings; and then those engravings are but copies, and often very rude copies, of their originals; while in the case of Albert Durer, it is quite clear that it was his own identical designs that were transferred into the metallic relief. Wood-engravings, too, are limited in point of size, because they can only be executed on box-wood, the width of which is very small; in fact, we have no wood-engravings on a single block of a larger size than octavo; when the engraving is larger, two or three blocks are joined together; but this is attended with so much difficulty and inconvenience, that it is seldom done. From the specimens of metallic relief engraving, left us by Albert Durer, there is every reason to infer that he was under no such limitation, that he could produce plates of any size. Now the importance of such an invention will be immediately seen, when it is considered that if you could produce an engraving of a work of art with as much facility as you can produce in types a copy of manuscript, and you could work this engraving along with the letter-press, you would have works of the largest size illustrated to a degree that is now unattainable, and might multiply copies of works of art with twenty times the celerity, and at more than twenty times less expense than you can do now. No wonder, therefore, the re-discovery of this invention has been so long a desideratum. Many are the persons who have tried to accomplish it; and I know of more than one or two who may say they have succeeded. About the year 1824, a Mr. Foulis, well known as an eminent printer in Glasgow, communicated to me that he had made a re-discovery of this art; and he produced a letter from the late Mr. Roscoe, of Liverpool, upon the subject, in which that gentleman gave it as his opinion that the art had existed; and from what Mr. Foulis had stated to him, that he believed he was in possession of the secret. I introduced Mr. Foulis to two other gentlemen for the purpose of bringing this art into use if possible. We joined together, and furnished funds for fitting up an establishment for the purpose; but after some time differences arose, and the thing dropped without being brought to a conclusion.

1636. Was that in consequence of want of protection?—Principally so; there was a difficulty arose on that head. Mr. Foulis was between 70 and 80 years of age, and we were naturally very anxious that he would leave us some specification of the invention, that we might be able to work it out, to indemnify us for the expenses we were incurring. However, Mr. Foulis could not be prevailed with to give us a sufficient specification, and we never received it from him. He wished that we should take out a patent for our mutual protection; but had a patent been taken out, that would have led of necessity to the publication of the specification; and it seemed to us that were it once published, the invention would be lost as a matter of property to all concerned. I may mention that the differences I have alluded to, led to an arbitration before Mr. Bolland, now Baron Bolland, in which arbitration the question was raised, whether such an art as I have described did really exist or had existed. A great deal of evidence was adduced on this point, and a number of artists examined, and the result was, to prove, beyond all dispute, that the art had existed, and had been lost.

1637. Is Mr. Foulis alive?—I believe he is dead, and probably the secret, as far as he was concerned, died with him; but more recently, about 18 months ago, an eminent engineer in town, who was aware of the interest I had taken in this subject, came and informed me that a friend of his had made the same discovery. To put this at once to the test, I gave him from a portfolio a small

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specimen of a paper pattern, and he pledged himself that his friend would, next morning, produce a fac-simile of it in relief. The next morning he actually brought it me, done in relief, and done admirably; it was a pattern of very great difficulty, and a copy of it could not have been executed with the hand within the time, nor executed half so well. I was perfectly satisfied from this, that the art so much sought after had been once more re-discovered. The gentleman, however, not being himself an artist, was desirous of disposing of this secret. It was suggested, as before, to take out a patent; but the answer to this was, that if patented, he must then specify the process, and it would be immediately pirated in every garret in London. It was impossible, in fact, that a patent could give him any protection at all. The case of Sir David Brewster's kaleidoscope furnishes an illustration exactly in point. He took out a patent for it; but it was so universally pirated that he could not protect it, and he made little, if any, profit from an article which, if it could have been adequately protected, might have yielded him a handsome fortune.

1638. Have any suggestions occurred to you as to the best mode of protecting such inventions?—I do not know any mode by which a property in inventions of this description could be protected; what I would suggest is this, that there should be an annual public grant for the reward of such useful inventions as the patent law cannot protect. In the present instance, all that the party asked was the sum of 500*l.* for the communication of his important secret; and because there is nobody to give him this sum, he keeps the secret locked up in his breast, and very probably it may be lost again to the community.

1639. You suppose that there exist no means of protecting, and that there only exist means of rewarding such inventors?—Yes.

1640. Is your opinion against the possibility of protection generally in other inventions of art?—Against the possibility of protecting those inventions only which can be practised by such numbers of persons in obscure holes and corners, that to vindicate the property in them by legal process is impossible; you cannot prosecute a whole nation.

1641. Cannot you prosecute one individual?—Yes; you may prosecute and put down one or two, but when every body infringes, and you have to prosecute every body, your right becomes practically a complete nullity. Where could be a stronger proof of this, than the case of Brewster's kaleidoscope, which I have just mentioned? although the undoubted inventor of it, he was powerless against a multitude. It may be said, that an inventor so circumstanced, can apply to the Society of Arts, but the premiums of that society are so small, and awarded by committees of so little select a description, that the authors of really valuable inventions do not often trouble it.

1642. You would recommend, not a system of protection, but a system of reward?—In cases of the peculiar description I have mentioned, there are many cases where a patent will effectually protect.

1643. Must not you bring proof that it is an original design before a reward is given?—I think there might be a commission of learned and intelligent persons appointed, before whom an inventor might go and submit his invention without much risk of his being able to deceive them as to its originality or ability. I would have this commission empowered to reward most liberally every new invention or improvement which they thought likely to be of national benefit; and that at once, in order that the author might have every enjoyment of the fruits of his ingenuity, and be left free to exercise his talents in the production of other inventions and improvements. They should, in fact, act on the same principle as the Society of Arts, but with larger means. Many useful inventions have been brought forward through the medium of the Society of Arts. I believe that steel engraving, which has done such wonders for the fine arts, was first introduced in consequence of one of their premiums; but I apprehend that were the entire number of inventions which have been rewarded by this society compared with the number carried into actual practice, the disproportion would be found enormous; and this I attribute principally to the smallness and inadequacy of their premiums.

1644. Is not it a good guarantee for the ultimate success of an invention, that the artist appeals to the tribunal of the public for a decision upon the merits of it?—Yes, a very good guarantee for the success of the invention, but not a guarantee for the fruits of that success coming into the inventor's pocket. If an inventor can go into the market to supply the public demand, I think the public feeling is such that

that they will patronize him in preference to any pirate or interloper; but it is not every inventor who has the means of doing so, and there are many, such as amateur mechanics, who though they may have the means, have not the inclination.

1645. Would not there be some danger in interposing an intermediate tribunal between the public and the inventor; would it not be leaving too much to their judgment, and rendering the inventor too independent of the final tribunal, which ought to decide upon it, namely, its merit in the eyes of the public?—I think the occasional loss to the public would be very small, and the advantage in a general view of the matter would be extremely great.

1646. Have you ever turned your attention to the expediency of giving every advantage to our artists of seeing, without any expense, beautiful works of art?—I think they cannot be made too universally accessible.

1647. Is there any want of natural design and taste in the artists of this country?—Not at all; I believe they are equal to anything that they can be put to.

1648. Has justice been done to them in allowing them a free inspection of works of art?—I do not think it has.

1649. Is not it highly expedient that such exhibitions should be encouraged?—Highly expedient.

1650. Have mechanics' institutions had a good effect in improving the taste of the artizans?—They must have had a good effect, but I should say not so good an effect as might have been expected, or such as they are calculated to produce under more judicious direction.

1651. In what respect?—I think, generally speaking, there is a want of system in mechanics' institutions; there is no regular course of instruction followed in any of them. When a young man has attended for two or three years, the circumstance of his having so attended suggests no definite idea of what he has learned during the time, or what course of study he has gone through.

1652. You would wish for more system in instruction and greater uniformity?—I should like some systematic course of instruction, suited to the wants of mechanics to be followed. The lectures given at these institutions often embrace subjects very foreign to the purposes of mechanics' institutions. All sorts of topics are discussed, and in every variety of order; there seems to be no principle of selection adhered to whatever.

1653. Do you think it desirable that to a certain extent the nation should assist in the formation, or in the construction of edifices to be devoted to the instruction of artizans in the arts?—I should be very jealous of the interference of Government.

1654. The question does not refer to interference, but simply assistance without interference?—I should hope more from the Government's undoing what it has done in the way of obstruction to the progress of the fine arts, than from anything it can do to promote them.

1655. What obstructions do you refer to?—To the heavy tax on paper, for one thing. Drawing papers are exceedingly expensive to persons of small means, and inferior papers are often used in copper-plate printing, when but for the tax, which is in proportion to the weight, much finer papers would be used, papers better calculated to do justice to the engraving.

1656. Would not the withdrawing of such obstructions by Government be in fact an assistance by Government?—It would amount to the same thing.

1657. Instead of giving additional speed to the machine, you remove the load that obstructs its progress?—Exactly so; and I would recommend the removal of all duties upon the importation of foreign prints; and also, that the Government should do their best to induce foreign Governments to do so likewise by our works of art. The import duty into this country is small, I believe, but still it operates to a certain extent.

1658. Would you think it desirable that any national assistance should be given, as in the case of building the schools without the slightest interference on the part of the Government, but simply that where the local resident population had advanced a certain sum, the Government should assist in the completion of the design?—I should think it highly expedient that the Government should give such limited assistance for the establishment of buildings, and probably some allowance also to the professors.

1659. You think that the interference of Government is a burden?—It is too apt to lead to jobbing, but benefactions simply can do no harm. Supposing the inhabitants of a place were to come forward with two-thirds, Government might

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with great propriety, and without the least risk of evil consequence, assist with the other third.

1660. Supposing that by the residents in any given district an offer was made to contribute a certain considerable proportion towards the formation of a gallery of casts, or a public library, or a collection of works of art, open freely to all the public, you think it would be wise in the Government, without the slightest degree of interference, simply to assist in the completion of the design?—I should think it highly expedient and highly honourable in the Government to give every encouragement in that way, to promote by all possible means the establishment of museums and galleries, so that they leave the management of them to the people themselves.

1661. Is not it probable that eventually the nation would be repaid for the passing liberality of the Government?—I am satisfied of it; the more the taste of the country is improved, the more our manufactures will be improved; and the country that has the best manufactures will of course command the greatest export trade in the long run.

1662. Are there any fiscal impediments to the circulation of abundant copies of drawings about the country?—Nothing but the expense; the duty upon paper is heavy; there are duties too of various kinds which make provisions and wages higher than they need be, and there are duties upon the importation of foreign prints; I believe also that our prints are not admitted to the Continent as freely as they ought to be.

1663. Does the Excise duty on paper materially obstruct the circulation of works of art among the people?—I should think it does; it enhances the price very much.

1664. Do not you think that our machinery and our capital offer to us a new mode of circulating a knowledge of the principles of art among the people in the application of that machinery and that capital to embellished works?—I believe that if books could be more generally and abundantly embellished than they are, if the embellishments could be as readily furnished on a large as on a small scale, and particularly if designers and artists could give fac-similes of their own designs, that would raise the arts to a much higher standard than they have ever yet attained in this country; and all this I believe to be now within our reach; encouragement and protection alone are wanting. By such an art as that of Albert Durer's, the standard would infallibly be greatly raised. It would not only abridge the time, labour and expense of production in themselves, and cause works of art to circulate among the people to twenty times the present amount, if not more, but make the people familiar with works of a much higher character than they have ever been before accustomed to. By the present mode of printing engravings with the roller-press, you cannot produce above 400 copies a day, whereas you might produce 20,000 from a plate in metallic relief, with equal ease, and all excellent impressions; impressions, too, not from copies, as even the best of engravings are, but of the artist's own original designs. You cannot, by the finest engravings in intaglio, give by any means so just a representation of the works of a Raphael or Michael Angelo, as a copy of the works of Milton or Shakspeare, executed by the meanest printer, conveys of the genius of either of these great writers. An engraving, by a secondary artist, of a good painting, like an ordinary translation of a first-rate poem, is always sure to lack much of the beauty of the original.

1665. Is there any thing else you wish to state to the Committee?—I would mention one instance, to show the great importance of multiplying copies of good designs, and making them as cheap and easily attainable as posssible. An ingenious mechanic in Scotland, of the name of Hunter, has invented a machine, a stone-planing and stone-turning machine; he cuts vases out with it; he will cut a large vase out in one day, hollowed and every thing complete, which would take a man a week to produce by hand. He is now fitting up a turning apparatus for the purpose of producing a large supply of vases next winter, and he wrote to me to get him copies of the vases at the British Museum and in other collections in town. I have accordingly made a collection, which I shall send down at considerable expense to him. I mention this as an illustration of the importance of having cheap copies of all our good works of art; for copies will find their way, as in this instance, where museums cannot.

1666. When you say copies, do you mean casts or drawings?—Drawings would do very well for the purpose I have just mentioned; but casts would be much better.

Veneris, 4° die Septembris, 1835.

WILLIAM EWART, ESQUIRE, IN THE CHAIR.

William Wyon, Esq. called in; and Examined.

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1667. YOU are chief engraver of the Royal Mint?—I am.

1668. You are also an associate of the Royal Academy?—I am.

1669. You reside in London?—I reside in the Royal Mint.

1670. Previously to that did you come from Birmingham?—I came originally from Birmingham; I have left Birmingham 20 years.

1671. Have you had opportunities of observing the arts as connected with manufactures in Birmingham?—Twenty years ago I was very much in Birmingham, and since that I have had occasional communication with that place.

1672. What is the result of your observation upon the subject?—The result of my observation at that time was decidedly that there was a want of proper and due encouragement to the arts, as related to manufactures in that town. My attention about ten years ago was particularly directed to that subject; and on the establishment of the Society of Arts in Birmingham, I expressed to one of the committee a strong desire, that instead of having a society simply for the encouragement of the higher departments of the arts, it would be also desirable to direct the attention of the society to that species of decorative design required in the manufactures of the town.

1673. What are the principal manufactures in Birmingham, in which instruction in art is necessary?—I would wish rather to confine myself to that particular class to which my attention has been most directed, which is principally silversmiths, or plated and brass work.

1674. What are the observations you would offer to the Committee as applied to those branches?—The principal remark is the defective state of the designs; they are obliged to have continual recourse to the works of the French. For example, when one series of designs have run out of fashion, there is frequently a want of supply for another, and they are obliged again to have recourse to the French. Some few years ago I recollect that the style that prevailed about the time of Louis XIV. was very much in fashion. Now it is changed to the modern style of the French; but still it is French that they look to, rather than originating designs of their own.

1675. To what do you attribute this use of French designs?—I attribute it to the want of encouragement and protection given to the arts in Birmingham. It is almost invariable, that those that draw for the manufacturers are obliged, for want of proper and due encouragement, to go to other departments of the art—to painting and sculpture; they become, instead of good designers for ornamental work, second, or third or fourth-rate artists in painting and sculpture.

1676. Have you had an opportunity of appreciating the knowledge of art of those persons who are ornamental designers at Birmingham?—I have occasionally, and I think it susceptible of great improvement.

1677. What are the principal defects?—Want of originality.

1678. Are they correct in their knowledge of outline and proportion?—Certainly not; they are not well educated in that respect.

1679. Do you consider that the French are superior to them?—I think they are very superior, because there is a purer style derived from the study of nature and antique sculpture; if you look at the clocks, candelabra, and all those kind of decorations, they are always more beautiful than anything we have produced.

1680. Which is the more correct, the English or the French designer?—When figures are introduced the French are more correct.

1681. Is correctness an essential ingredient in the education of an artist for manufactures?—It is very important. The taste that I should like to see would be derived from studying nature and the works of the goldsmiths of the 15th century, and works of that class; I think it would greatly improve them, if they had an opportunity; but they are generally very poor, and have not the means of obtaining access to the works that I think would be advantageous to them.

 1682. Are

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1682. Are they educated in that which you may call the "truth" of art, meaning by that the real correctness of it?—Their education is defective.

1683. That which depends upon certain principles?—They have no certain principles to go upon.

1684. What schools are there in Birmingham for the educating of manufacturers in art?—The principal one, with the exception of private schools, is at the Society of Arts, where they have a good collection of casts from antique sculpture.

1685. Is there no school of design connected with the mechanics' institution there?—I believe there is a drawing class at the mechanics' institution.

1686. Have you any open galleries or exhibitions of works of art accessible to the public at Birmingham?—There is an annual exhibition of modern works of art, and I believe every other year of the old masters.

1687. Is that exhibition open to the public without any fee?—They pay for the admission 1*s*.

1688. Is the gallery of the Society of Arts accessible to all the public without any fee?—No.

1689. Is it open to persons who are not subscribers?—No.

1690. Are the greater number of the artizans subscribers?—I believe not.

1691. Is it open throughout the year?—I believe it is.

1692. Is the subscription such as that it would be a restriction upon the working classes visiting such an institution?—I think the greater facility the better.

1693. Do you think that the slightest impediment thrown in the way of any person frequently prevents him from doing that which he would do if it were an exhibition gratuitously open to him?—I think that if a museum was instituted for the class I have mentioned, it would be more serviceable if it were gratuitous.

1694. Do not you think that any fee, however small, must be an impediment to the diffusion of the arts among the labouring classes?—That is a question that requires a great deal of consideration; it appears to me, that if there is not some little fee for instruction they would not be so desirous of availing themselves of it.

1695. Are you aware that a very slight impediment existed in the admission of persons to the British Museum, the removal of which has increased the numbers frequenting the Museum?—I am aware that there was such impediment; it was simply that of signing the name upon the admission, and since that slight impediment was done away with the number of persons that have been to see the Museum has greatly increased.

1696. Is it your opinion that that increase of number has resulted from the removal of that impediment, or at least that that has had a considerable effect in increasing the number?—I think so, decidedly.

1697. Do not you think, that if your establishment were open to persons that were not subscribers to it, it might be frequented by many that might in consequence contract a desire to become acquainted with the arts so as to improve themselves as workmen?—I think it is very likely.

1698. Have you any institution in Birmingham which teaches that intermediate portion of education of an artizan which relates to the peculiar adaptation of the art of design in which he has been instructed to the trade which he has to pursue?—There is nothing of the kind, and that is precisely the defect of which I complain; I think it would be highly desirable that something of the kind should be introduced.

1699. Have you ever thought of any means of forming such an institution?—The plan which I proposed some years ago, when the Society of Arts was being established, was that there should be the kind of connexion formed which I have already mentioned, and that premiums should be given for the most successful designs for candelabra and for epergnes, and for that particular class that is most manufactured in Birmingham; if in addition to this there was a good library, containing works of an ornamental character, it would be very beneficial.

1700. Would not a sufficient premium be found in the general demand for such objects?—I think not; I think that they require emulation.

1701. Are there persons connected with the manufactures of Birmingham employed as designers?—There are a great number of artists employed as designers who are modelers and designers.

1702. Do they receive encouragement if they are ingenious and clever men?—Not sufficient to keep them to that particular department.

1703. Do you consider that the want of encouragement arises from the imperfection of their designs?—There wants emulation and protection to be offered to them to induce them to continue that particular class of art, instead of wandering to other pursuits.

1704. You were understood to state that there was a demand for those metallic productions, but that the designs were made in France and not in England, and that the cause was the want of instruction among those who produced the English designs?—I think the designs would be improved if the artists were better educated.

1705. Do you think that if the designs for the metallic manufactures were improved, the demand would increase?—I am certain that it would.

1706. Would not that of itself be a natural and sufficient premium for the artist who devoted his life to making designs for manufactures?—I should think it ought to be, but it does not appear to be so.

1707. A previous question was put with reference to the propriety of establishing institutions which should teach the artizan the application of the arts to the particular manufactures to which he intended to devote himself; do you think that that should form a portion of the education of an artizan?—I do, most distinctly.

1708. How would you carry into effect such a scheme?—The plan that I proposed was particularly with respect to silversmith's and brass-work. I think that if there was a museum with free access and premiums offered, so as to induce them to improve themselves in that particular branch, it would affect the manufactures, and the taste would be greatly improved.

1709. How would you create the means of producing that which you wish to be imitated?—I should create it by models to draw from, that is, casts from the most beautiful pieces of the antique, particularly casts from the works of the goldsmiths of the fifteenth century, which have not been sufficiently attended to; and by this means I see no reason why we should not have a Benvenuto, Cellini or a Flaxman, who has done more for that branch of the art than any other person, by his Shield of Achilles, and other designs of a similar kind.

1710. How would you enable them to profit by the exhibition of the models?—By drawing from them.

1711. Do you recommend any machinery of instruction independent of the exhibition?—I should have a school for instructing them in their particular branch of art. Instead of studying simply from casts of figures, although very essential, I should like to have them also study from those particular ornamental kinds of work in demand.

1712. In fact you would let them have, first a general education in design, and afterwards superadd the application of that particular knowledge of design to the particular manufacture, and the particular material upon which the artizan was to employ his labour?—Yes.

1713. Would you make that the business of early instruction?—I should begin at a very early period.

1714. You would introduce drawing into the elementary schools?—Yes.

1715. Then you would have peculiar schools applicable to the peculiar manufactures?—Precisely.

1716. You would also have galleries containing the finer works of art open to the public?—Yes.

1717. Would you make that as extensive as possible throughout all the large towns in the country?—Throughout all the large towns; but in towns such as Sheffield, and Birmingham and Manchester, they should have museums, if you may so call it, of the works that are particularly applicable to the branch of manufacture that flourishes there, independently of schools for the higher departments of art.

1718. Do you consider that the plan you have suggested of appropriating particular schools to particular branches of manufacture, would not only educate the artizan peculiarly for that manufacture, but also would have the advantage of creating a greater division of labour, and producing all the good effects of that division of labour?—I do, certainly.

1719. Have you ever turned your attention to consider the propriety of making instruction in art a portion of the education of all the people?—I think the people themselves require education in art in order properly to appreciate art, and at the present time the public are just as likely to encourage a very inferior

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pattern as anything that is really beautiful, for want of a general dissemination of taste throughout the country.

1720. Do you think it desirable in any comprehensive and general system of national education to make design to a certain extent a portion of the education of the people?—I certainly do; but the only way to educate the people in that particular class would be to have as free access as possible to works of art.

1721. Do not you think, as reading and writing are made a portion of education, and as music is made a portion of elementary education, you might also educate the eye?—It has often been a source of very great regret to me, that at our universities and at other public seminaries, the arts of design are not considered an essential part of education.

1722. Is it possible to make instruction in design to a certain extent a part of national education?—I should think it would be quite possible.

1723. Is not it the practice now in some infant schools to give the children instruction in proportion, and to exercise their eye on the subject of form?—I have not made this a subject of inquiry.

1724. Do you consider that the early elementary education of the people in art, would increase the means of applying art to the manufactures of the country?—I think of that there cannot be the slightest doubt.

1725. Do you consider that such a system would increase the demand for manufactures as connected with art?—Most assuredly.

1726. Do you consider that such a system would extend the employment of the people, by enabling them to employ faculties which they are not able to employ at present?—Most assuredly.

1727. That is to say, the supply of art would create a demand for art, and the demand for art would in its turn create a supply of art?—Yes, and the morals of the country would be greatly improved by creating a new taste.

1728. What is your opinion as to the state of art as applied to metals now, as contrasted with its state a few years ago; is there a general improvement or not?—I should say decidedly not; there is no great improvement. Chasing, which is a very important branch of the arts, is at quite as low an ebb as it was some years ago. There is no perceptible improvement within the last 20 years, and it frequently occurs that when good designs have been obtained, they have been injured by inferior execution.

1729. Is there not a great demand, in consequence of the increase of wealth, for articles of the precious metals, which are susceptible of the application of decorative art?—I believe that upon the whole the demand for manufactured works in the precious metals have increased.

1730. Is not there a great increase of demand for silver-plated goods to which art may be applicable?—I have understood that there is.

1731. What do you consider to be the epoch of the highest art as applied to metallic substances?—Unquestionably the finest bronzes in existence are derived from the ancient Greeks; but the gold and silver works of Cellini and his time are eminently beautiful; there are also remarkably fine works from Germany about the 15th century.

1732. Do many specimens exist of the productions of that period?—A great number.

1733. Was France in the 15th century at all distinguished for the application of the arts to metals?—Yes, it was, and also about the period of Louis XIV.

1734. Can you give the Committee a comprehensive view of the progress of art as applied to metallic substances?—A satisfactory answer to this question would fill a volume.

1735. What do you consider the best period of the application of art to metals in England?—I have seen very fair specimens about the time of Elizabeth and James I., the period of Charles the First and Second; there are many beautiful productions.

1736. Do not you imagine that the metal dies of Thomas Simon, in the time of Charles I. and the Commonwealth, had a very remarkable effect in encouraging the taste for art?—I should think so; the coins of Simon were very fine, and very superior to those of his foreign rivals the Roettiers; I think a very unfortunate thing in this country is the circumstance of there being no medallic establishment; we have no medals except those which emanate immediately from the enterprize of individuals, which are struck in haste and worked off without much consideration.

tion. It appears to me that if a series of medals were promoted by the Government, it would tend very greatly to the dissemination of taste throughout the country.

1737. Do not you think that the influence of the great circulation of the different medals struck by Buonaparte in relation to the interesting events of history, had a great deal to do with the creation of the love of art which is universally allowed to exist in France?—I do, decidedly.

1738. Do not you think that a cheap and more extensive circulation of medals among the people might be made instrumental in creating both a love and a knowledge of art?—My view has been frequently directed to that particular, and I have been also very anxious that the copper coinage should become to a certain extent historical; I should like to have recorded upon the coinage the most remarkable events, and likewise any discoveries in science.

1739. Do not you think that the infinite variety of coins that issued from the mints of Greece and Rome, with the multitudinous designs on the reverses, and their very various character, must have been an important element in the creation of the taste of Greece and Rome?—Decidedly I think so.

1740. Supposing the head of the monarch were constantly preserved, and the reverse of the coinage frequently changed to accommodate itself to the events of the time, might not such frequent changes be made very instrumental in creating and extending a better taste among the people?—I think so decidedly; but it might be attended with inconvenience to the public if the designs for the reverses of the gold and silver coinage were frequently changed, from the difficulty of identifying the legal coinage; I do not think it so objectionable in varying the reverses of the copper money.

1741. Do you think that the circulation of the money of the country might be made instrumental in creating a great demand for art among die engravers?—That has always been my opinion.

1742. Would you vary the reverse upon a coin of the same denomination, or would you only vary the reverse upon coins of different denominations; for instance, would you vary the reverse upon a shilling?—I should myself keep the gold and silver to one type, that is a type that is well understood by the country at large, and reserve the variety of designs to the copper coinage.

1743. Are you aware, that in the periods of antiquity a great variety is to be found in the silver coinage?—Yes, but I apprehend that arose from a great many small states each coining their own money.

1744. Would there be any difficulty in accommodating a great variety of design to a perfect identity of weight?—Not the slightest, the difficulty would be with regard to relief; we cannot imitate the ancients in relief, our mode of coinage would not allow it.

1745. Might not the most beautiful coins of antiquity be re-produced or imitated in the present day in coins not for ordinary circulation; would it not be possible to create coins of twenty or thirty guineas in gold, or of ten or twenty shillings in silver, which should be made legal tenders, but which should only be used to a certain limit for the purposes of circulation, and might they not be a means of advancing art?—Quite so; it is a matter which has occupied my mind very seriously of late to improve the coinage of the country by having a five-pound piece of this description.

1746. Is not it the fact, that even now our coinage is preserved in the cabinets of the curious?—Proof impressions of the coinage in fine gold and silver are sought for with great eagerness; collectors of late are much increased.

1747. Is it your opinion that if such a scheme were adopted the demand for purposes of curiosity, or for purposes of circulation would be such as to justify the expense?—Beyond all doubt.

1748. Do not you think it would be convenient to have a portable coinage of certain denominations between a sixpence and a penny?—I think a three-penny piece in silver would be very desirable.

1749. Has not the taste in or-molu ornament increased to a great extent within the last few years?—I believe it has, very considerably.

1750. Is there not a demand for ornaments of that kind now, which did not exist comparatively a few years ago?—I believe so; but I would rather not give evidence upon subjects that I have not sufficiently considered.

Wm. Wyon, Esq.

4 Sept. 1835.

1751. Are you aware that artists of the highest class have been employed in producing works of that description?—I have not observed them, sufficient to give an opinion.

1752. Are you aware that some of the houses give the greatest encouragement to artists?—Most assuredly; Rundell & Bridge, and others, employed Flaxman and Bailey, Stodhard and Howard, and other artists of celebrity, some years ago.

1753. Is there any inferiority in our highest class of artists, as compared with those upon the continent?—I think that the artists in this country are superior in most branches of the fine arts, in reference to designs for metals; Flaxman's Shield of Achilles is superior to any thing of the kind in existence.

1754. If this higher class of artists have been employed in those works of late years, how do you reconcile that with the opinion you have expressed respecting the inferiority of those works in general?—Artists of that eminence have been rarely employed by manufacturers.

1755. In those metallic manufactures, to which your attention has been directed, is good art cheap or dear?—High talent ought to be well paid.

1756. Therefore if Flaxman and the greatest artists were employed, they must have been employed for the luxuries of the few, rather than the consumption of the many?—Certainly.

1757. Is not it very desirable for the manufactures of the nation that art should be cheap?—I think so.

1758. How do you account for it, that such specimens of art existing in this country have not been copied, and that a better taste has not gradually got amongst the workmen?—They have been too limited.

1759. Is there any want of native talent for art in this country?—Most assuredly not.

1760. It only wants development?—It only wants development.

1761. If the higher class of artists had had these beautiful specimens before them of the 15th century, and others, to what do you attribute the fact of such specimens having been so little copied in the general class of productions which have been executed in this country?—I think the want of access to them. It is a curious circumstance, that occurred to me two days ago. An artist from Birmingham applied to me, asking me to put him in the way of getting designs from the French works, and I was lamenting with him the difficulty he experienced. Being himself very poor, he had no means of purchasing the works, and he had no means of copying them.

1762. Have you ever turned your attention to the want of protection to the inventors of original designs in this country?—Not sufficiently so; but I know that there is a great want of protection, and that the manufacturers have frequently complained of their works being pirated; that after having gone to a very great expense in the production of any article to suit the taste of the time, it had been pirated, and therefore it is not worth their while to employ the best artists for the purpose.

1763. Have you ever peculiarly directed your attention to the best remedy for this evil?—No, I have not.

1764. Has your attention been at all directed to any prompt and economical means of giving and securing a copyright for designs in metallic substances?—I can hardly say that it has, sufficiently to give an opinion.

1765. Under the present system, does not a difficulty arise not only from the extent of the piracy, but from the expensiveness of the protection, wherever it is given by the law?—I have always heard that there was great complaint of the want of a summary remedy.

1766. Are you aware of the fact that there is a strong feeling as to the inefficiency and the expense of the legal remedy as it now stands?—I am.

1767. Do you think it would be easy to create an efficient tribunal, competent to distinguish what is copyright, and prompt and inexpensive in its decisions?—I think it might be done.

1768. Would not it be easy to create a tribunal in which artists themselves might be called in as judges?—I should think it would be.

1769. Would there be any great difficulty in deciding the fact of copyright in matters of design?—I should think not.

1770. And even though there might be some difficult cases, is there not a very great number of piracies which could be at once recognized as piracies and punished as such, if a competent tribunal were established?—I think so, if the tribunal was not expensive.

1771. Would

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1771. Would it be desirable, in your opinion, that the copyright should last long, or would you only give it a transitory recognition?—I should think for that class of productions a very temporary recognition would be required, because the fashion varies so much that it would not be necessary to extend it to a long period.

1772. What period of protection do you imagine would be sufficient in ordinary cases?—Not more than five years, I should think.

1773. Do you think the duration of the protection should vary according to the nature of the article to be protected?—I think so, decidedly.

1774. Do not you think, that in addition to the present protection offered to works of art being tardy, costly and vexatious, the tribunals at present established are in addition incompetent to make fair decisions?—With regard to the incompetency, I think it is very likely that the decisions are generally just, but it is impossible to obtain summary justice.

1775. Would you think the Privy Council a fit tribunal to decide upon the priority of the invention of a work of art?—Certainly not.

1776. Or the Court of King's Bench?—Certainly not.

1777. Or the Court of Chancery?—Certainly not.

1778. Have you ever considered to what extent protection should be given to works of art; whether it should only be given to an original design, or whether to a combination from a previous model?—That is a question which I would rather consider before I answered it.

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APPENDIX.

Appendix, No. 1.

Appendix, No. 1.

Letter from Mr. Skene dated 25 Nov. 1829.

LETTER from Mr. *Skene* on the subject of the EXPOSITION of ARTICLES of MANUFACTURE in *France*.

My dear Lord, 25th November 1829.

IN answer to your inquiries relating to the recent establishment in France, of what is there styled "The Exposition of National Industry," I beg to send you my notes on the subject, if you should find time and patience to peruse so dry a detail.

Having had occasion to witness the last display of that kind in Paris, I felt strongly impressed with the advantages which appeared to result from it; in exciting a general interest amongst all classes of society in that country in the advancement of industry, and in the progress of improvement, as well as in ascertaining the actual state of the productions, and exercise of all the multifarious branches of manufactures, and of mechanical ingenuity. At present the scheme is highly popular in France, as every thing which affords subject of national exultation is likely to become in that country; and particularly in this case, where the assembling from all quarters and the public display of the most successful performances only, in the different branches of manufacturing industry practised in the country, places their skill and success under so favourable a comparison with that of neighbouring nations, whose exportation productions (not always the most perfect) naturally become the subjects of comparative judgment. And this circumstance itself is to them a source of advantage, as the conviction of successful rivalry which it creates, stimulates to increasing efforts, in order to render the victory thence supposed to be attained over their rival, more and more triumphant. During the continuance of the Exposition, the merits of the various productions become the subject of general discussion and interest, and the names of the most skilful competitors are enumerated with pride; while every one engaged in the prosecution of any branch of industry, or possessing aptitude for invention, here enjoys the advantage of inspecting freely whatever has been most successfully achieved in any branch; he also gains valuable information, or perhaps possesses himself of a hint which may be improved into important discoveries. And thus, while the public becomes essentially benefited, the manufacturer and expositor of every class obtains the most advantageous promulgation of his individual merits, and secures to himself a reputation for skill and proficiency in his particular branch of trade, which is likely to prove to him substantially beneficial; others are here enabled to ascertain the most fitting quarters in which connexions in trade may be formed; and in all, a spirit of emulation is excited, which is the sure earnest of rapid improvement, and is, perhaps, the best security against the continuance of imperfections or slovenliness of work among the competitors for employment in every branch.

But this extent of attraction and benefit, which, under existing circumstances attends the scheme of exposition in France, is not likely to be the consequence, to its full extent, of similar attempts made elsewhere. France having recently set forward on a new course of industry, enterprise and emulation, sharpened by the characteristic energy of its people, and by their love of novelty, now displays as great vehemence in pursuit of the peaceful laurels of industry as a matter of pride as well as of profit, as ever she did for those of territorial conquest; and the public is, consequently, ready to embrace whatever is pointed out as likely to feed its appetite for national exultation. France possesses an advantage likewise in the extraordinary accumulation and variety of the products of industry and invention which are freely poured in from all quarters, but which, in almost any other country, would probably be yielded with reluctance and diffidence; and among them are presented many objects of so frivolous a description, that elsewhere they could only excite ridicule, and occasion the fastidious to withhold their more important products from forming a part of such an assemblage; whereas in Paris, such eccentricities and trifles are good-humouredly placed to account of the exuberant fancy and genius of their nation; and if they excite a smile, it is that of admiration and not of ridicule. Nevertheless I feel satisfied, that even at the advanced stage of manufacturing skill to which this country has attained, and in spite of the habitual disposition of its industrious classes to persevere in the stedfast course of their practice, whatever it may chance to be, which is recommended by long experience; and in spite of the reluctance they generally show to bestow a thought on what bears the suspicious character of novelty, some useful hints towards the encouragement, improvement and the means of stimulating exertion by honorary rewards, might be borrowed from the French system. Viewing it merely as an extension

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Letter from Mr. Skene, dated 25 Nov. 1829.

of the plan which has been so long and (although upon a small scale) so successfully pursued by the Board of Trustees, and as an endeavour to accommodate the encouragements intended by that plan, to the progressive change which time brings about in the character and objects of industry, its being merely an enlargement of this existing plan, might serve to elude the difficulties and more easily to overcome the reluctance, which would otherwise be probably opposed to any attempt of an entirely new character. I shall, therefore, point out the particulars of the French system, from which your Lordship may judge how far any portion might be attempted here with the prospect of advantage.

The idea was first started in France in the year 1814, since which time three successive Expositions have taken place in the lower galleries of the Louvre at Paris, the last of which, in the close of the year 1827, I had an opportunity to witness. They have been now fixed to take place periodically every fourth year, under the sanction and personal inspection of His Majesty, who takes great pleasure in witnessing the display and in distributing the prizes. The more immediate management is entrusted to a board of twenty-two persons, under the presidency and superintendence of the Minister of the Interior, and is composed of an union of men of rank and influence, with a proportion of persons conversant with the sciences and manufactures. The view of engaging a minister of the Crown in the direct management, is for the purpose of being authorized to call upon the active employment of the local authorities of the different provinces of the kingdom to promote the objects of the establishment.

These local authorities are accordingly enjoined, by an official letter, to point out the advantages afforded to the manufacturing classes by the Exposition, to stimulate their enterprise and to encourage them to prepare objects for competition,—to remove any obstacles which may impede these efforts,—to prepare a suitable receptacle for goods or inventions offered for exposition,—and to appoint a jury of skilful persons to inspect the objects offered, and judge whether they are worthy and proper to be forwarded to the Exposition, and without whose sanction they cannot be received,—to see that, in the exercise of this scrutiny, the jury do not reject such articles as may be of a coarse and ordinary nature, provided they be of a description conducive to utility or to a reduction in the ordinary price of such commodities,—to rouse the emulation of manufacturers, and instruct them that the Exposition is by no means confined to articles of novelty, but extends to every display of increased proficiency whatever, in matters of national industry.

All expenses in the transmission and return of the articles are paid by the board, so that the local check and examination becomes important in preventing useless transmissions and unnecessary expense. Every object must have a number and local mark attached to it, to be entered in a schedule circulated to the provinces for that purpose, and returned to the board prior to the transmission of the goods. The expositor has likewise to accompany his transmissions with a written detail relative to the articles, and some account of his manufactory, in which he may insert any observations he is desirous to promulgate; all which being printed and circulated at the expense of the board, becomes an important advertisement for the manufacturer. He is, moreover, invited to state any means of encouragement which he conceives might be beneficially extended to his line of business.

There is no limitation as to the description of objects entitled to admission at the Exposition, provided they are instrumental to the advancement of arts and manufactures, and do not interfere with matters more adapted to compete for the recompenses of literary and scientific societies; even inventions of a description which do not admit of a specimen being exhibited, may, upon authentic certification, be publicly recorded at the Exposition, and entitle the owner to reward. In fact, it is a general display of national industry and genius, to which every one is admitted to present his best endeavours towards proficiency of any kind, in the useful and elegant arts, and to receive the reward due to his success.

So soon as the arrangements of the Exposition are completed, small committees of the board, with the assistance of persons of practical experience, are appointed to inspect the different classes of objects, and to give in their report, suggesting the objects most deserving of commendation, and the persons to whom honorary medals of different values or sums of money ought to be awarded. The selected objects are distinguished by a ticket, and the Exposition is thrown open to the public, under regulations which ensure the safety of the articles exposed and their convenient inspection.

A division into classes is observed in the arrangement of the articles, of which I shall state the general character, and add such observations as may occur to me relative to any of them.

1.—Wool of different qualities and dressings, in whole fleeces,—the premium dependent on the amount of stock, combined with the quality.

2.—Woollen yarns of different textures, stating the nature and extent of the proceeding followed in the manufacture of them.

3.—Woollen cloth of every kind, from the coarsest fabric to the best superfine broad cloths, under their distinctive names, and describing their particular merits and uses.

4.—Cashmere shawls, and others of many different materials.

5.—Silk

5.—Silk stuffs of every quality and description, such as satins, velvets, crapes, gauze, embroidered silk, taffetas, bobbin-net, ribands, fringes, &c.

6.—Linen yarn, and stuffs from sail-cloth to the finest cambric, including damask.

7.—Cotton yarn, and stuffs of all qualities and kinds, a numerous class.

8.—Lace, blonde, gauze and tamboured work, with fancy embroidery, in all its varieties, in which the French excel as much in taste as they do in the comparative cheapness of their needlework.

9.—Artificial flowers, of which the display is most attractive and brilliant. This branch of industry so important, as affording the means of subsistence to thousands of indigent females in the higher as well as lower stations of society, is nearly monopolized by France; and yet it has to be recollected, that, not long since, Italy was almost in the exclusive possession of this valuable resource, that France took it up at second-hand; and although the general diffusion of the knowledge of design, which is the foundation of the superior taste of the French, in works admitting of its exercise, has enabled them to carry the trade of artificial flower-making to great perfection, there is no reason against its being taken up elsewhere, and an endeavour made to supply this productive resource to a very numerous and dependent class of society. A great advantage arises from the small cost of the necessary stock of materials and requisite tools; from its being beneficial, on however small a scale it may be conducted; from the circumstance that it can be pursued at home and unaided, by the class to whom the fewest resources of profitable industry are open; and that taste and fancy find here an unlimited field for their advantageous exercise. For, in all the changes and caprices of fashion, the taste for artificial flowers, as a requisite of female ornament, seems to have stood the test of every vicissitude.

11.—Stuffs of various materials, printed in colours, stamped and stained in a variety of ways, affording an uncommonly beautiful display, and of singular variety, in which the beauty of colour, design and pattern, stands pre-eminent in France, with the exception, perhaps, in the brilliancy of Swiss dye.

12.—Articles manufactured of leather of every class.

13.—Paper manufactured in all its branches.

14.—Straw hats and bonnets.

15.—Carpets and tapestry. In the carpet trade, much remains to be learned by the British manufacturer in the elegance and variety of pattern, as well as in the structure of loom capable of executing richer and more varied patterns. The power of the British carpet-loom is generally confined to four threads, and, consequently, to four colours; while some of the foreign manufacturers have devised means of extending the capacity of their looms to eleven.

16.—Painted velvet of beautiful execution.

17.—Wax and floor cloths, transparent blinds, and such like.

18.—Paper hangings, carried to great perfection, and superior to the British, although only one-fifth the expense; the piece is purchased at three francs in Paris, which costs 15*s.* or 17*s.* in England.

19.—Dyeing and bleaching. The art of dyeing is particularly superior in Switzerland, where a different process is pursued, and different materials used; particularly the Indian substance called Lack-lack, in the use of which the Swiss seem unrivalled, even by the French, although the latter maintain their superiority over the English. They have recently substituted the prussiat of iron for indigo, as being cheaper, and producing a more brilliant and imperishable blue. Notwithstanding the eventual profit which any discovery in this branch of manufacture is generally attended with, and which of itself ought to stimulate invention, the causes of superiority in some of the foreign dyeing processes seem a fit matter for deeper research than that process has hitherto met with; which arises probably from the unwillingness of qualified persons to undertake the expense of inquiry at their own private risk.

20.—Specimens of the useful minerals of the country, including the various kinds of building stones, ornamental marbles, &c. and imitation stone.

21.—Articles of manufacture in metals; iron, copper, brass, bronze, tin, zinc, &c.

22.—Wire, and objects manufactured of that material.

23.—Tools of all kinds, with a descriptive catalogue of their uses; a very curious display of ingenuity.

24.—Cutlery, and locksmiths' work.

25.—Fire-arms.

26.—Bronze, and plated ornamental goods. Here is particularly conspicuous the characteristic of French manufacture, where the agency of a superior knowledge of design is perceived operating in the most trifling matters, and diffusing a degree of elegance and taste which is exceedingly attractive.

 27.—Jewellery

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Letter from Mr. *Skene*, dated 25 Nov. 1829.

27.—Jewellery.

28.—Agricultural instruments, and processes described.

29.—Hydraulic machines.

30.—Instruments, mathematical and astronomical.

31.—Clock-work.

32.—Musical instruments.

33.—Articles connected with chemistry.

34.—Colours, varnish, and wax.

35.—Porcelain and glass productions.

36.—Painting and staining glass.

37.—Cabinet and joiners' work.

38.—Typography, calcography, and lithography; with specimens of engraving on copper, steel, and wood.

39.—Bookbinding.

40.—Miscellaneous articles, comprehending an extraordinary variety of objects of industry and invention, such as the expositor may expect either to be productive of profit or distinction to himself in giving them publicity, or likely to become a source of benefit and interest to the public. This class is, accordingly, altogether unlimited, and seemed with the generality of visitors to be the most attractive.

When a prize is awarded to a person who had formerly received one for similar productions, he receives, instead of a second medal, a diploma confirmatory of the distinction. The sanction which is thus given by continued public approval, and the publicity of the artist's skill and quality of the goods he manufactures, has been always found productive of the greatest advantage to the individual, and a successful stimulant to the industry and emulation of others.

This is perhaps the most effectual means a public body is possessed of, to urge on the advance of improvement, at the small cost of honorary prizes, the expense of giving publicity, and of removing, or abating at least, the obstacles which the unaided efforts of genius and skill may be unable to surmount, in giving the assurance to persons striving for distinction, of the regular periodical return of opportunities of exhibiting their successful efforts in any branch of industry whatever, and in furnishing skilful and enterprising individuals with the means of acquiring knowledge of the successful proceedings of foreign manufactures; to which may be added, the procuring for the use of manufacturers and artizans, foreign patterns, with models and designs applicable to the different branches of manufacture. The production of these last objects is not in France left to the invention of manufacturers; a distinct occupation is created out of it, from which a numerous class of artists derive their subsistence, and persons of high eminence are not unfrequently engaged profitably in this humble pursuit; so that a rich and varied succession of novelty in patterns is placed at the command of the manufacturer, who is freed from the necessity of urging any pattern beyond profitable limits, as commonly happens in this country. A judicious selection and regular supply of patterns from this source, would be an easily acquired and valuable boon to manufacturers.

Nothing further occurs to me at present with reference to the Exposition; and I remain,

My dear Lord,

Very faithfully yours,

J. Skene.

126, Prince's-street, Nov. 25, 1829.

To the Hon. Lord Meadowbank.

Appendix, No. 2.

RETURNS relative to the National Gallery.

A RETURN of the Number of Officers, effective and superannuated, connected with the National Gallery; the Amount of their Salaries, with the Duties and Conditions of their Appointments, and the other Situations held by such Officers.

OFFICES.	Names of the Officers.	Salary. per Annum.	Date of Appointment.	DUTIES and CONDITIONS of the APPOINTMENTS.	Other Situations held by the Officers.
1. Keeper	William Seguier, esq.	£. 200 -	March 31, 1824.	-- To have charge of the Collection, and to attend particularly to the preservation of the pictures; to superintend the arrangements for admission; to be present occasionally in the Gallery; and to value and negociate, if called upon, the purchase of any pictures that may be added to the Collection, and to perform such other services connected with the establishment of the Gallery, as he may from time to time be called upon to do by instructions from the Lords Commissioners of the Treasury.	-- Surveyor of the King's Pictures.
2. Assistant Keeper & Secretary.	G.S.Thwaites, esq.	£. 150 -	March 31, 1824.	-- To attend in the Gallery on the public days during the hours of admission; to carry into effect and superintend, under the direction of the Keeper, any arrangement it may be necessary to make for the admission of the public, and in regard to the Artists who may be permitted to study in the Gallery, and to act as Secretary in the making of any communications, or the promulgation of any rules and regulations for the exhibition of the Gallery, by order of the Board; the whole of his duties being to be executed generally under the direction of the Keeper of the Gallery.	-- On half-pay, as a Captain of Infantry.

N.B.—The above are the original appointments; and there are no superannuated Officers.

A RETURN of the Days and Hours on which the National Gallery is open and closed.

THE GALLERY IS OPEN	THE GALLERY IS CLOSED
To the Public on the four first days of each week, from 10 till 5 o'clock; and to the Artists and Students on the Fridays and Saturdays during the same hours; in both cases, with the exceptions stated in the next column.	On Christmas-day and Good Friday; it is also closed for an annual Vacation for six weeks, computed from the end of the second week in September in each year, in lieu of all other holidays, on which it is invariably open; and to furnish the Keeper with an opportunity of examining minutely into the state of the pictures, making necessary alterations in their arrangements, &c. and causing the Galleries to be thoroughly cleaned, the frames dusted, &c. &c. &c.

A RETURN of the Number of Students who have attended for the purpose of studying in the National Gallery in each of the last Five Years.

The Number of Students on the Books is at present 702, who are allowed to study in the Gallery at all times, during the days set apart for that purpose, as may suit their convenience. No account of their particular attendance has been kept.

A RETURN of the Attendants and Servants employed at the National Gallery.

SITUATIONS.	NAMES of the Persons holding the Situations.	SALARY.	DATE of Appointment.	DUTIES and CONDITIONS of the APPOINTMENT.	Other Situations held by the said Persons.
1. Attendant in the Gallery.	J. P. Wildsmith -	-- 2 guineas, per week, when in attendance.	Mar. 31, 1824.	-- Constant attendance in the Gallery, to give information to the public, and to see that no injury occurs to the pictures.	
2. Ditto - -	J. Weeks - -	- ditto - ditto -	- ditto -	The same as above.	
3. Ditto - -	T. Rimer - -	- ditto - ditto -	Oct. 29, 1827	The same as above.	
4. Police Officer in attendance at the door.	J. Upson - -	-- £. 1. 4. per week, when in attendance.	Mar. 31, 1824.	-- To see that no improper persons find their way into the Galleries, and to assist the Porter in taking charge of umbrellas and sticks.	
5. Porter - -	Henry Newham -	£. 80 per annum	- ditto -	-- The usual duties of a porter, and to take charge of umbrellas and sticks.	-- Yeoman of the King's Guard.
6. Housemaid -	Martha Hirst -	£. 50 per annum	- ditto -	-- To sweep and keep clean the Galleries, stairs and furniture of the Galleries.	

N. B.—There are no superannuated Attendants or Servants.

National Gallery, Sept. 7, 1835.

William Seguier, Keeper.

Appendix, No. 3.

Appendix, No. 3.

Paper delivered in by *C. Toplis*, Esq.

PAPER delivered in by *Charles Toplis*, Esquire.

LONDON MECHANICS' INSTITUTION, Established 2d December, 1823.

29, Southampton Buildings, Chancery Lane.

President.—Dr. Birkbeck.

THE Institution is established for the purpose of enabling Mechanics and others to become acquainted with those branches of Science and Art that are of practical application in the exercise of their respective Trades and Professions.

The Subscription is 1*l.* 4*s.* yearly, or 6*s.* quarterly, and 2*s.* 6*d.* entrance, paid in advance. Members may also be admitted at the half quarter. Sons and Apprentices of Members have the privilege of attending either the Evening Classes or the Lectures, at 3*s.* per quarter. The sum of 10*l.* constitutes the Donor an Honorary Member for life.

Library.

The Library for circulation contains upwards of 6,000 Volumes, treating of every branch of Science and general Literature; and the most important Reviews, Magazines, &c. are regularly supplied. Accommodation for perusing the works at the Institution is afforded in the

Reading-Room,

From Ten o'clock in the Morning until Ten in the Evening. The Reading-Room is also supplied with Morning and Evening Newspapers, for the perusal of which the Room is opened at Nine o'clock in the Morning.

Lectures.

Public Lectures on the various branches of Experimental Philosophy, Chemistry, the Fine Arts, &c. &c., are delivered in the Theatre of the Institution every Wednesday and Friday Evenings, commencing at half-past Eight o'clock precisely.

Single Lecture Tickets, at 1*s.* each, may be obtained on application to the Secretary.

Evening Classes.

The attention paid to this truly valuable and efficient mode of improvement will be manifest upon an examination of the following List of Classes.

No. of Members in each Class.	Average Attendance.	SUBJECTS OF STUDY.	TEACHERS.	Evenings of Meeting.
73	50	English Grammar	Mr. R. Daniel	Monday.
40	- -	Writing	Mr. T. Hall	Saturday.
36	18	Arithmetic	Mr. J. Collins	Thursday & Saturday.
20	10	Mathematics	Mr. J. Collins	Monday.
45	40	Practical Geometry	Mr. H. Barnard	Tuesday.
39	28	Drawing, Architectural, Mechanical, Perspective, and Ornamental	Mr. C. Davy	Monday and Thursday.
26	16	Drawing the Human Figure	Mr. H. B. Jenkins	Saturday.
12	10		Mr. E. Anderson	Tuesday.
	12	Modelling	Mr. C. Fines	Monday and Thursday.
30	25	Landscape Drawing	Mr. J. Noblett, assisted by Mr. E. Anderson	Thursday.
	40	French Language	Mons. Fischere	Thursday.
	12	Latin Language	Mr. J. Robson.	Thursday.
In last class, 50		Short Hand, occasionally.		

In addition to the above, the following Classes have been formed on the principle of mutual instruction:—

No. of Members.	Average Attendance.	SUBJECTS OF STUDY.	Evenings of Meeting.
45	38	Literary Composition	Tuesday.
33	22	Chemistry	Tuesday.
45	- -	Experimental Philosophy	Saturday.
	30	Geography	Monday.
	32	Natural History	Thursday.
Suspended at present.		Phrenology	Saturday.

There is also a class for the study and practice of Music, the Teachers of which are paid by the Class - - - No. of Members, 90.

The Museum

Is furnished with extensive collections of Specimens, arranged to illustrate the sciences of Mineralogy, Geology, &c., as well as with suitable Apparatus and Instruments for illustrating the Mechanical and Chemical Sciences, &c. &c.

The affairs of the Institution are conducted by a President, four Vice Presidents, a Treasurer, and thirty Committee-men, elected periodically by ballot; to which privilege every Member is eligible six months after entrance.

The Rules and Orders of the Institution, price 6*d.*, and the Catalogue of the Library, price 9*d.*, may be obtained in the Library.

Average Number of Members for the last three years, - - - 1,069.

Average Receipts of Money for the last three years, - - - £. 1,640.

Andrew M'Farlane, Secretary.